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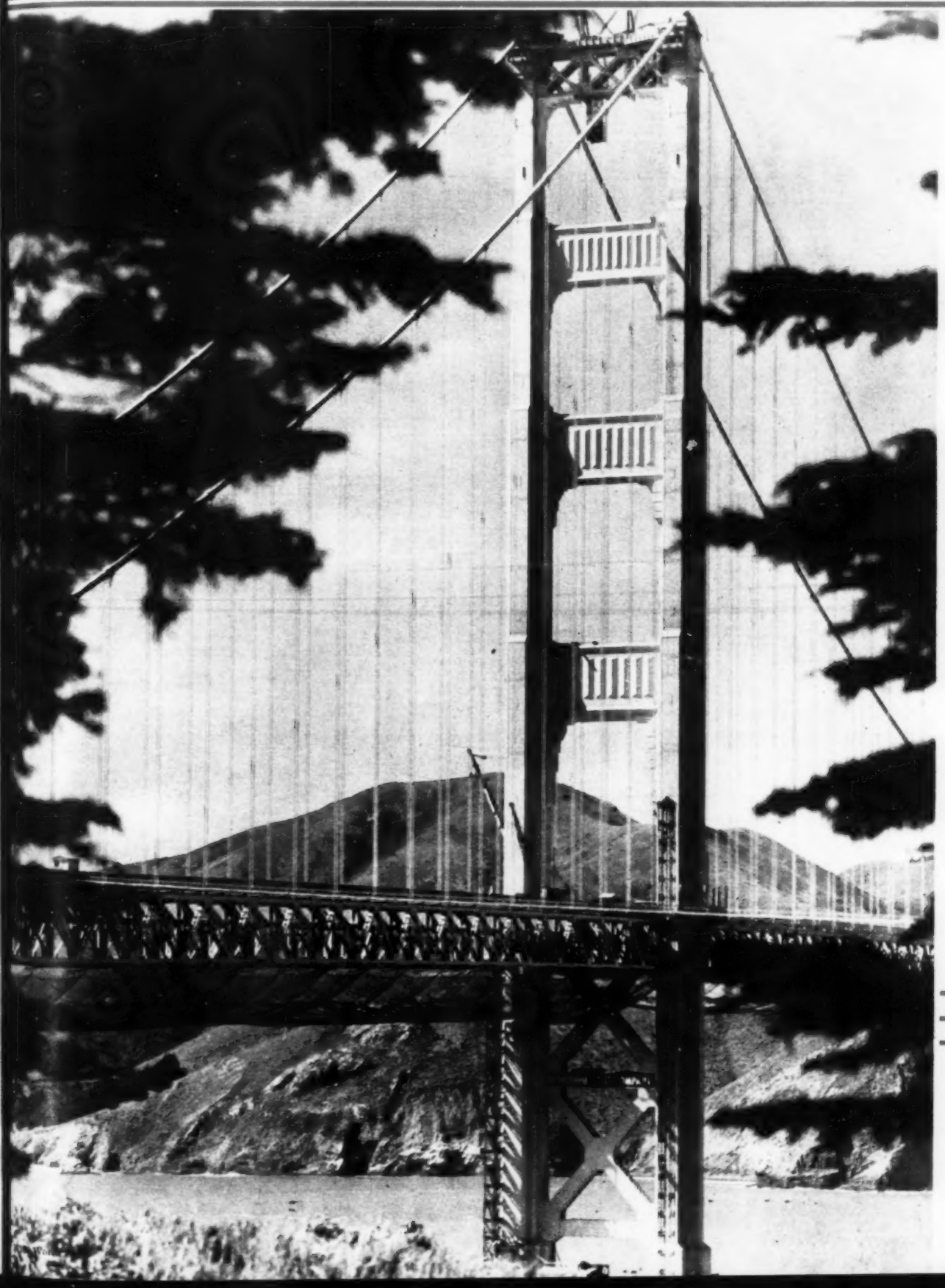


In This Issue:

The Problem of

LABOR RELATIONS

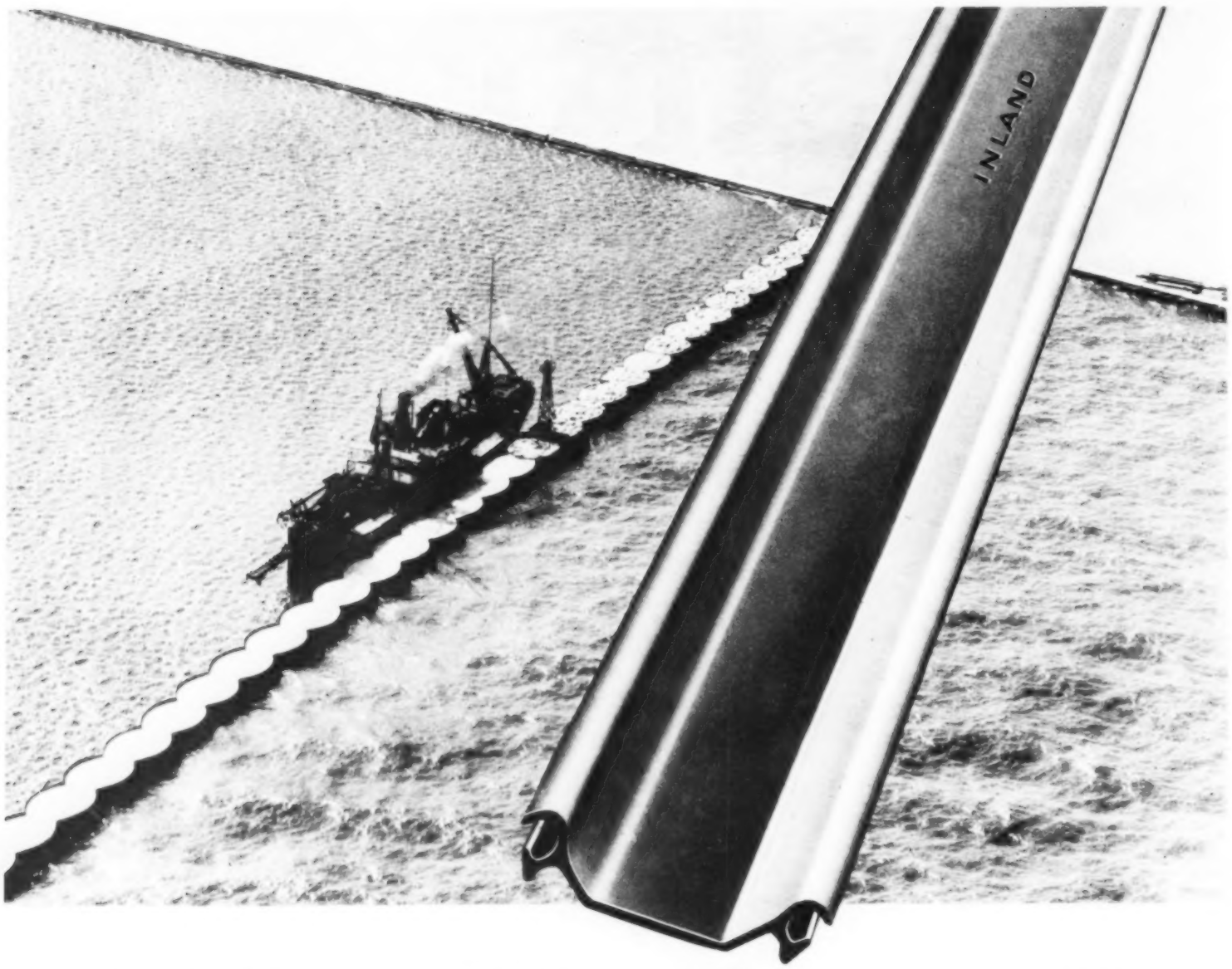
—And a Plan for Its Solution In the Construction Industry

By

ARTHUR A. JOHNSON

President, Arthur A. Johnson Corp., New York

GOLDEN GATE BRIDGE, with its record breaking cable suspension span of 4,200 ft carried across San Francisco Bay by steel towers 700 ft high, was completed and officially dedicated last month



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TECHNOLOGY DEPT.

CURRENT JOBS

. . . . and Who's Doing Them

Construction Methods and Equipment

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JUNE, 1937

Buildings

Public — In Boston, Mass., a $3,962,500 contract for the Suffolk County Court House was awarded to **John Bowen Co.**, of Boston. Low bidder on a city hospital building on Welfare Island, New York City, was **Cauldwell-Wingate Co.**, of New York, with a tender of $3,711,000. For Schonowee Village, a PWA mass housing project in Schenectady, N. Y., the successful bidder was **A. E. Stephens Co.**, of Springfield, Mass., with a price of $893,620. **Psaty & Fuhrman, Inc.**, of New York City, obtained $772,000 contract for court house in Brooklyn, N. Y. In Chicago a low bid of $751,255 for the PWA's Jane Addams housing project was submitted by **Patrick Warren**, of Chicago. An additional unit of the Williamsburg mass housing project in Brooklyn, N. Y., a PWA job, was obtained for $757,000 by **Starrett Bros. & Eken, Inc.**, of New York City. A hospital building in New Orleans, La., went to **R. P. Farnsworth & Co.**, of New Orleans, for $715,380. The bid of $674,377 by **N. P. Severin Co.**, of Chicago, was low for a federal jail at Sandstone, Minn.

Commercial — An art gallery building for the Mellon Trust, in Washington, D. C., to cost $10,000,000, is under construction by **Marc Eidlitz & Sons, Inc.**, of New York City. For the New Union Passenger Terminal in Los Angeles, Calif., an award of $1,300,000 was made to **R. E. McKee**, of Los Angeles. A 20-story office building, to cost $1,250,000 is under construction in Dallas, Tex., by **Henger Construction Co.**, of Dallas. In Bayside, N. Y., a group of 300 houses, to cost $1,000,000, has been started, under separate contracts, by **Gross-Morton Corp.**, of Bayside. A $1,000,000 residence development in Upper Darby, Pa., is in progress by **J. H. McClatchey**, of Upper Darby. **Wilson Sullivan, Inc.**, of Albany, N. Y., is building in that city 74 two-story, air-conditioned residences to cost $1,250,000. A chapel building, to cost more than $1,000,000, in Darlington, N. J., was bid in by **Consullo & Burke Construction Co.**, of Union City, N. J. **McCloskey & Co.**, of Philadelphia, are at work on a $1,000,000 store building in Upper Darby, Pa. An $800,000 contract for an apartment structure in Dundalk, Md., was awarded to **C. L. Stockhausen Co.**, of Baltimore. **Hegeman-Harris Co.**, of New York City, is engaged on a $500,000 housing development at Grand Island, N. Y.

Industrial — A $5,000,000 Chevrolet factory contract in Tonawanda, N. Y., was awarded to **S. E. Pentecost Co.**, of Detroit. In Jacksonville, Fla., **Merritt-Chapman & Scott Corp.**, of New York City, is contractor for a $3,260,000 pulp mill for National Container Corp. New York State Electric & Gas Corp. is building a $2,000,000 power plant at Dresden, N. Y., for which **McCloskey & Co.**, of Philadelphia, is general contractor. For the Acme Steel Co., at Riverside, Ill., **Lundoff-Bicknell Co.**, of Chicago, is constructing a $1,000,000 steel plant structure. In Chintermline, Ill., **Koppers Rheolaveur Co.**, of Pittsburgh, is building a coal cripple and washing plant to cost $500,000. A sub-station for Narragansett Electric Co. at Providence, R. I., is being built at a cost of $500,000 by **New England Power Construction Co.**, of Providence. **Rau Construction Co.**, of Kansas City, Mo., is at work on a $500,000 brewery in that city for Fontenelle Brewing Co. In Newark, N. J., The Public Service Electric & Gas Co. has engaged **United Engineers & Constructors** to build a $500,000 power plant. For a $400,000 shoe factory building in Beverly, Mass., **Morton C. Tuttle Co., of Boston**, is contractor.

Sewers

Low bidder for storm water and sanitary sewers in Brooklyn, N. Y., was **P. Tomasetti Contracting Co.**, of Brooklyn, with price of $1,627,947. At Greece, N. Y., **Couse & Saunders**, of Detroit, received a $1,200,000 contract for sewage disposal plant. An ocean outfall sewer at Miami Beach, Fla., to cost $533,000, is under construction by **Merritt-Chapman & Scott Corp.**, of New York City. For sewer construction projects in Buffalo, N. Y., aggregating $813,000, low bids were received from **P. Tomasetti Construction Co.**, of Buffalo, **McCarthy Bros. & Ford**, of Buffalo, and **La Macchia & Guadagnino**, of Hamburg, N. Y. With a price of $653,000, **Ligon & Ligon**, of Baltimore, Md., obtained contract for 23-mi. of sanitary sewers. In Davenport, Ia., sewer contracts amounting to $455,000 were awarded to **D. Keeler**, of Davenport, **Gjellefald Construction Co.**, of Forest City, Ia., and **G. Vella**, of Detroit, Mich.

Bridges

At Port Royal, Pa., a $223,639 state highway bridge on Route 45, is under construction by **J. H. Wickersham**, of Lancaster, Pa. Ohio awarded $662,705 contract for grade crossing elimination structures in Summit County to **Bates & Rogers Construction Co.**, of Chicago. For Bronx River bridge in Westchester County, N. Y., **F. T. Ley Co.**, of New York City, was successful bidder with price of $585,000. A viaduct in Chicago went to **Ketler-Elliott Co.**, of Chicago, for $564,388. At site of New York World's Fair of 1939, Flushing, N. Y., bridge substructure contract was awarded to **Corbetta Concrete Construction Co.**, of New York City, for $543,257. **Coleman Bros. Corp.**, of Boston, Mass., submitted a price of $488,000 for the substructure of the Deer Isle-Sedgwick bridge in Maine. By **Arute Bros., Inc.**, of New Britain, Conn., a low bid of $245,616 was submitted for highway grade separation structure and approaches in Norwalk and Westport, Conn. In Queens County, New York, **Johnson, Drake & Piper, Inc.**, of Freeport, N. Y., is building a $294,704 bridge.

Highways

State Highway Department, Toronto, Canada, has made contract awards to following: **Keystone Contractors, Ltd.**, of Windsor, $300,000; **Towland Construction Co.**, of London, $250,000; **Harvey & Irvine**, of Kingston, $250,000; **Rayner Construction Co.**, of Leaside, $220,000; H. M. Scott, Ltd., of Leaside, $500,000; **Dufferin Paving & Crushed Stone, Ltd.**, of East Toronto, $450,000; **Honsberger Construction Co.**, of Vineland, $220,000. In New Brunswick, Canada, recent large highway contract awards were: **Dexter Construction Co.**, of Fairville, $330,000; **Currier Construction Co.**, of Fredericton, $490,000; **McNamara Construction Co.**, of Leaside, $390,000; **Armstrong Bros.**, of Perth, $320,000; **H. J. O'Connell**, of Montreal, $450,000; **Rayner Construction Co.**, of Leaside, $610,000; **Tomlinson Construction Co.**, of Bathurst, $395,000; **Warren Bituminous Paving Co.**, of Toronto, $530,000.

The Mississippi Highway Department let contracts to **Gast Construction Co.**, of Warsaw, Ind., for $206,932 in Lowndes County; to **S. J. Groves & Sons Co.**, of Minneapolis, for $222,465 in Perry County; to **Stevens Bros.** and **Miller-Hutchinson Co.**, of New Orleans, for $316,340 in Sunflower County; to **Harrison Engineering & Construction Co.**, of Kansas City, Mo., for $306,000. In Wisconsin, **J. D. Bonness**, of Milwaukee, obtained a $277,411 contract. Illinois highway contracts included $208,578 and $129,278 to **J. C. O'Connor & Sons, Inc.**, of Fort Wayne, Ind. For Bronx County paving in New York a $392,299 contract went to **Rusciano & Son Corp.**, of New York City. Pennsylvania let a $331,467 highway contract to **E. H. Ellis**, of Westfield, N. J. In North Carolina **Brown Paving Co.**, of Lexington, received a $219,195 contract. Five miles of gravel road near Brunswick and Bath, Maine, were let for $218,887 to **Hendrickson Bros., Inc.**, of Valley Stream, N. Y. South Carolina awards included $222,768 to **Hardaway Contracting Co.**, of Columbus, Ga.

The "How" of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

How WAGE RATE CONFUSION makes difficult accurate estimates of construction costs. — p. 44
How INDUSTRIAL STRIFE might be ended by zoning states and determining wage rates by labor commission. — p. 45
How HIGHWAY UNDERPASS was built below electrified railroad freight trucks. — p. 46
How CONSTRUCTION IN FIVE STAGES was planned for building grade crossing structure. — p. 47
How TIMBER GUIDE supported steel sheetpiling for assembly and driving. — p. 46
How PILEDRIVING SHOE, weighing 1,500 lb., protected head of steel sheetpile from hammer impact. — p. 47
How CLAMSHELL BUCKET'S digging power was increased by double hinges and multiple sheaves. — p. 47
How BRIDGE MAINTENANCE is aided by fleet of motor trucks, specially equipped. — p. 49
How PIPE-LINE WELDING is speeded by modern methods and oxyacetylene equipment. — p. 50
How DOLLIES allow pipe to be rotated for welding in field. — p. 50
How PIPE CLAMP insures accurate alignment of pipe lengths for field welding. — p. 51
How PAVING MIXER, operating as part of plant in fixed location, produced batches for stabilized road base. — p. 54
How FLOATING RUNNERS of spreader box aided uniform distribution of road base material. — p. 54
How TWO BATCHING UNITS weighed ingredients for stabilized base mixture. — p. 55
How TRIANGULAR CHART indicated permissible percentages of ingredients in stabilized soil-stone mixture. — p. 55
How WATER SYSTEM on three-wheel road roller kept all wheels wet. — p. 56
How ROTARY DRILL RIG bored 3½-ft.-diameter holes for concrete-filled caisson piers. — p. 58
How PRECAST CONCRETE SLABS formed inclosing walls of apartment building. — p. 58
How VACUUM-COMPRESSION was applied to concrete poured in building walls. — p. 58
How EDGE-CUTTING ATTACHMENT on road grader produced accurate alignment along shoulders. — p. 58
How OXYACETYLENE TRAILER helped welding work of city water department. — p. 58
How IMPROVISED CRANE raised 3x12-in. by 25-ft., timber joists for factory building. — p. 59
How BRIDGE STEEL MEMBERS were unloaded from truck by gallows frame. — p. 59
How WELL POINTS, hooked to centrifugal pump, kept sewage plant excavation dry. — p. 63
How MIXING PLANT was planned to place 1,000,000 cu.yd. of concrete in 600 days. — p. 65
How GROUT CURTAIN was designed to cut off seepage in dam foundation. — p. 66
How FROZEN EARTH held back slide of unstable material at dam site. — p. 67
How STEEL PIPE CAISSONS are "spun" down into place by rotary rig. — p. 69

ROBERT K. TOMLIN, Editor — WILLARD CHEVALIER, Vice-President

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For Better Labor Relations

IN THIS ISSUE Arthur A. Johnson discusses briefly but pointedly the subject of labor relations as they apply to the construction industry. After sketching some of the hazards and uncertainties that surround the bidding and handling of construction jobs under prevailing conditions, he suggests a specific program for the determination of wage rates and conditions of employment and for competent and authoritative review of violation and complaints.

It is a fact that in the construction industries labor conditions are about as unsatisfactory as they are anywhere. They do not keep labor happy, they are onerous to employers, they are a bugaboo to investors and they are a headache to the general public. Rightly or wrongly, it is the vogue among professional and volunteer commentators outside the industry to attribute to labor conditions many, if not most, of the ills from which it suffers. Constantly we are assured that there would be more construction, better construction and steadier construction and that the entire economic and business cycle would be in much more healthy shape if only we could settle the "construction labor problem."

OF COURSE, that problem never will be "settled" any more than will any other industrial problem. Invariably we "settle" our problems by creating new ones; our problems change in nature but not in number. But if we are to have the reasonable stability and peace that are necessary to continuous progress, we must face the facts cited by Mr. Johnson and work out practical means by which we can cope with *today's* problems. Only by doing that can we hope to keep the health of the construction industry on a reasonable par with that of the other departments of business and industry.

Throughout Mr. Johnson's discussion we find bobbing up regularly those prize problems of the industry — "the problems that have made construction famous." One of these is the matter of seasonal employment: can regular employment at monthly or annual wages help to stabilize construction volume and costs? Another is the jurisdictional dispute: can such controversies between crafts be settled without the strikes that bear so hard on both employers and the general public, neither of whom is at fault, or even concerned in the trouble? A third is the responsibility of the leaders and organizations that represent and negotiate for organized labor: can these be made responsible and held responsible for any failure to perform on the part of those in whose behalf they have bargained with employers?

OTHER RELATED difficulties will occur to every construction man but many of them stem from these root problems. All of them rate some straight thinking and talking by the men who must grapple first-hand with the conduct of construction operations.

Mr. Johnson has had a long and intimate familiarity with his subject and what he has to offer deserves attentive reading and thoughtful consideration by everyone who has at heart the well-being and the progress of the industry. He has "busted" it; will other construction men take a cue on any side of the whole broad question?

Willard Chevalier

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But Real PRODUCTION FIGURES

RESULTS OBTAINED BY THE DRIVER COMPANY

• Actual working days	79
Hours of working day	23
Number of Trac-Truks	10
Total available Trac-Truk working hours	18,170
Total pay yards hauled—levee measurement	522,762
Average length of haul one way	2,200 ft.
Pay yards, levee measurement, hauled per available Trac-Truk hour—overall job average	29

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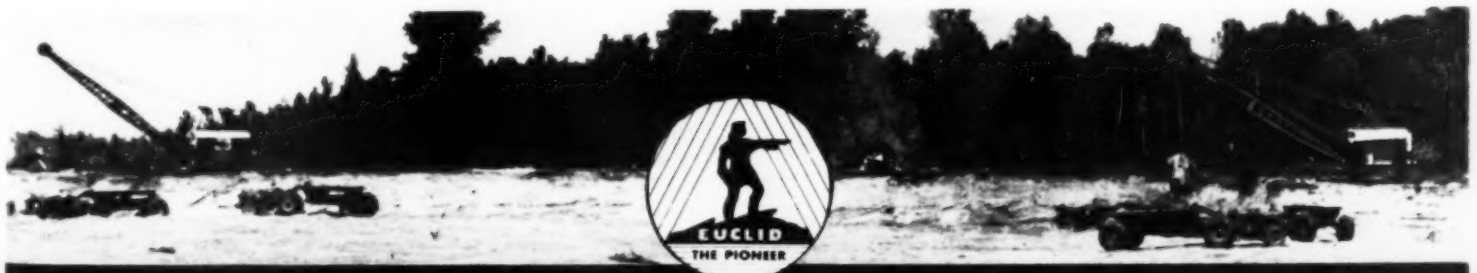
Excel on "Cycle-Time Production"

ON THE LEVEE!

It is the maintaining of moving speed and work capacity that count most in accumulating better final production figures. These Euclids, gifted from the start for such gratifying results, have contributed largely to the outmoding of former equipment methods in constructing River embankments and won foremost rank with this contractor—long a consistent user of Trac-Truks—known as a leading levee builder. Job facts, such as are recorded here, supply that assurance of quality and proof of performance sought in selecting the right equipment for the work to be done



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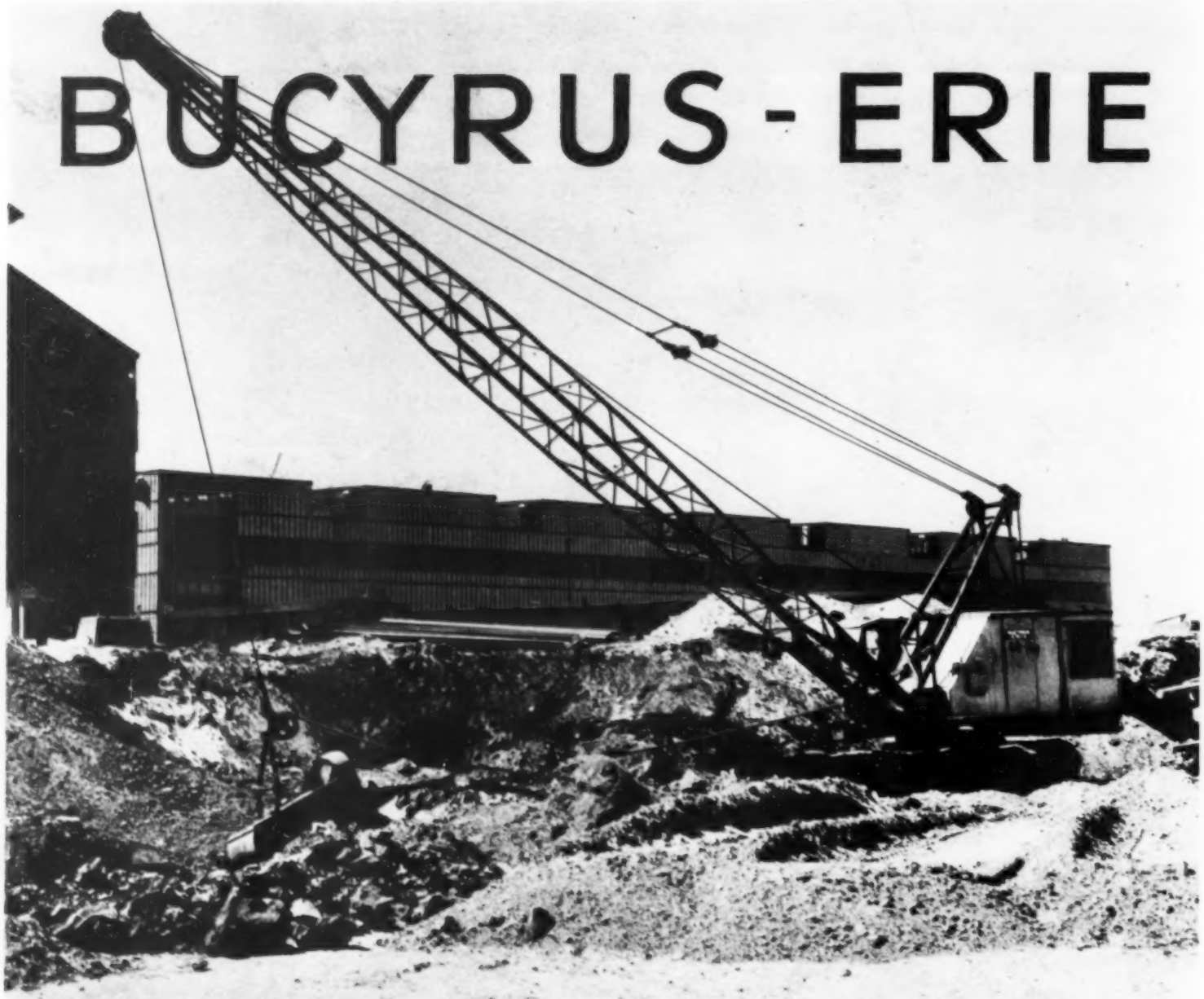
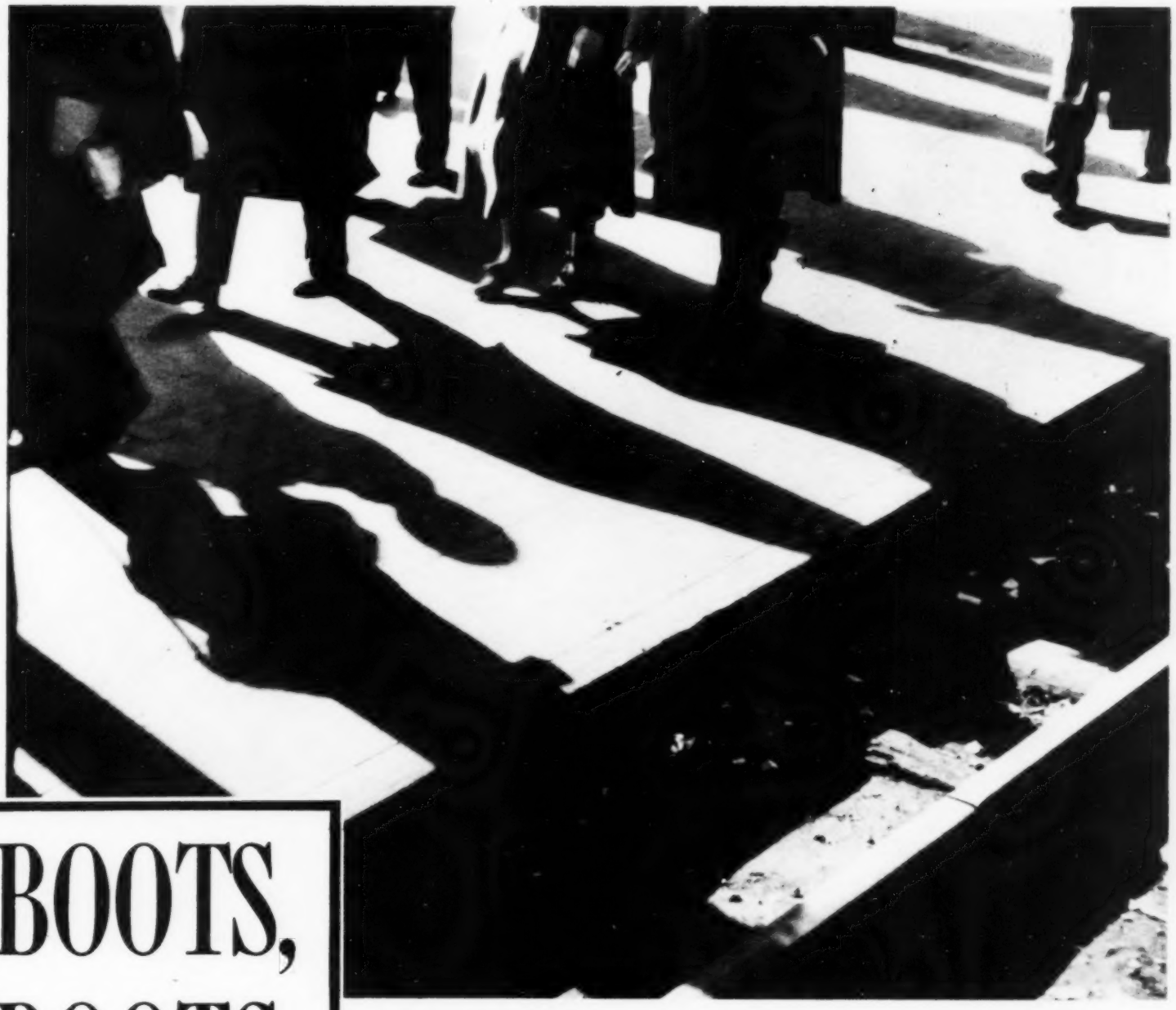
BUCYRUS-ERIE



With any front end THE MODERN BUCYRUS-ERIE 48-B IS OUT AHEAD WITH GREATER SPEED, POWER, AND STAMINA. DEADWEIGHT HAS BEEN ELIMINATED FROM THIS YEAR'S-AHEAD MACHINE SO THAT, POUND FOR POUND, IT DELIVERS MORE IN SWIFT ACCELERATION, HARD BITING DIGGING FORCE AND SHEER BRUTE STRENGTH THAN ANY MACHINE NEAR ITS SIZE-CLASS.

THIS 48-B DRAGLINE SPEEDS CLEAN-UP WORK FOR THE FOUNDATION OF A NEW INLAND STEEL COMPANY BUILDING AT INDIANA HARBOR, IND.

BUCYRUS ERIE. EXCAVATING, DRILLING, AND MATERIAL HANDLING EQUIPMENT... SOUTH MILWAUKEE, WISCONSIN, U. S. A.



'BOOTS, BOOTS, BOOTS—

MOVIN' UP AND DOWN AGAIN'

BACK IN 1929, Boston Terminal Company replaced South Station's steel and glass with individual umbrella-type platform structures. One at a time, platform wearing courses were concreted with 'Incor' Cement. Early strengths with 'Incor' saved weeks of delay waiting for concrete to harden. But, even more important than time-saving, 'Incor' makes better, longer-wearing concrete — because it cures thoroughly in the short time concrete can be kept wet.

Witness the fact that here, at South Station — where steel-tired baggage trucks grind the concrete day and night, and millions of passengers (1½ million a month, in summer) tread the surface — 'Incor' concrete is as smooth and sound as the day it was placed, eight years ago.

A ten-year record for producing quality concrete explains the trend toward 'Incor' in heavy-duty and watertight structures. For 'Incor', a more thoroughly processed Portland cement, cures thoroughly in a fraction of the usual time, making it ever so much easier to get strong, dense, watertight concrete. The kind of concrete engineers and contractors have been getting with Lone Star Cement ever since 1900. 'Incor'* and Lone Star Cements are made and sold by Lone Star Cement Corporation, New York. Sales offices in principal cities.

*Reg. U. S. Pat. Off.

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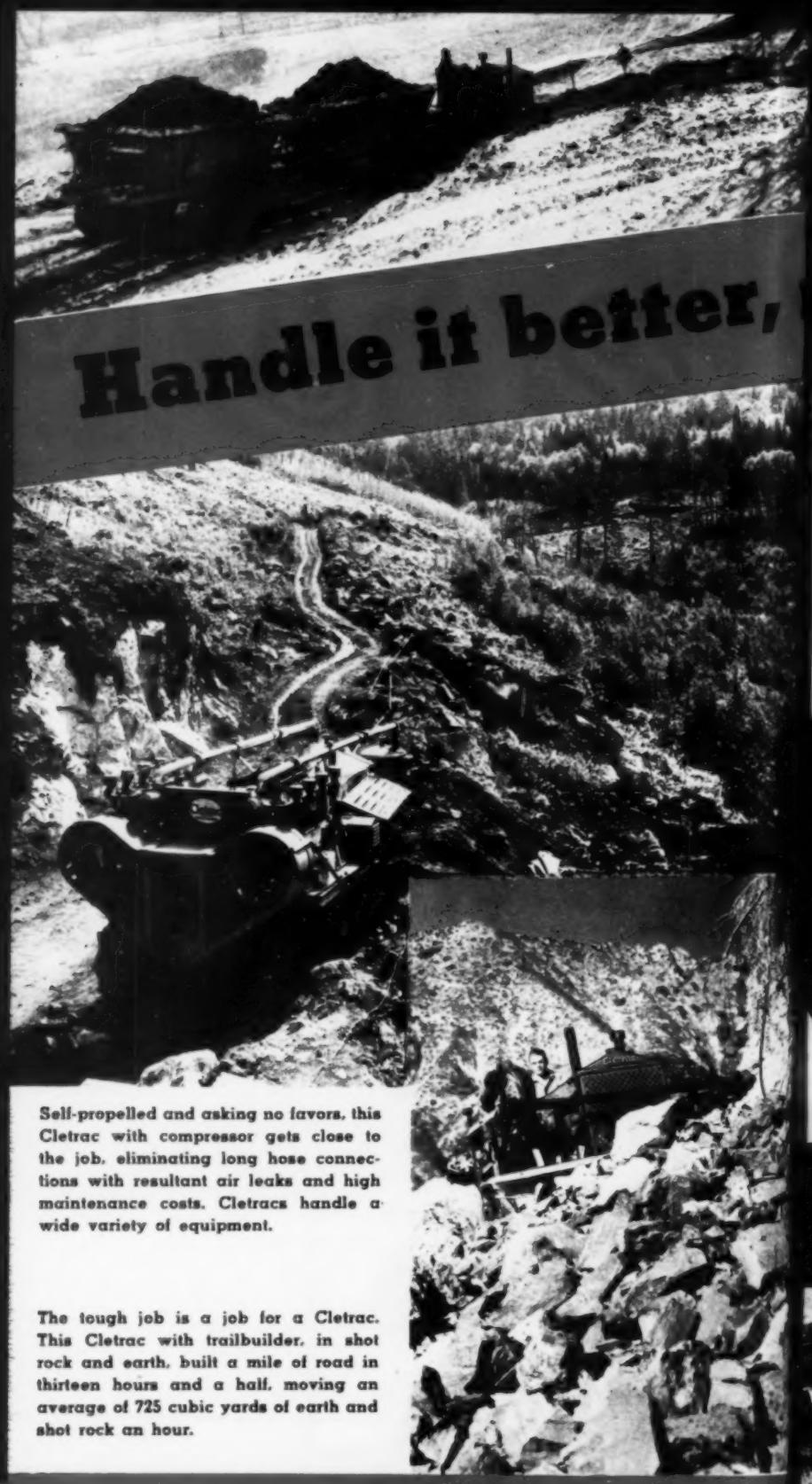
What's the job?



Handle it better,

Self-propelled and asking no favors, this Cletrac with compressor gets close to the job, eliminating long hose connections with resultant air leaks and high maintenance costs. Cletracs handle a wide variety of equipment.

The tough job is a job for a Cletrac. This Cletrac with trailbuilder, in shot rock and earth, built a mile of road in thirteen hours and a half, moving an average of 725 cubic yards of earth and shot rock an hour.

Cletrac

Crawler Tractors

Diesel, Tractor Fuel, Gasoline . . . Six Siz

...re economically with a Cletrac

...complete this 500,000-yard fill in the allotted 60 days. Cletracs had to move nearly 10,000 yards of dirt in a 12-hour day. That's moving dirt. But Cletracs are ...t for the big jobs.

...ough the heart of a red wood forest at Crescent City, ...ifornia goes a 9½-mile road, graded with four Cle... with scrapers. Total cost of the job was $690,000 ... required 670,500 yards of grading.

Cletracs are built for the tough jobs . . . to do the world's heavy work easier, more economically, better. Examine a Cletrac . . . its rigid main frame, its sturdy track frames, the dead axle shaft, the controlled differential steering, the accessibility, the soundness of every construction detail.

With its controlled differential steering — an exclusive Cletrac feature — the Cletrac turns short . . . pulls on both tracks while turning . . . handles larger loads on the turns.

Investigate the Cletrac and the complete line of working equipment — bulldozers, scrapers, air compressors, welders, post hole augers, rock crushers, front-end loaders, winches, booms . . . tools and equipment for every requirement.

Among the fifteen Cletrac models — gas, tractor fuel, or Diesel powered — there is the right size for every job, 22 to 94 horsepower.

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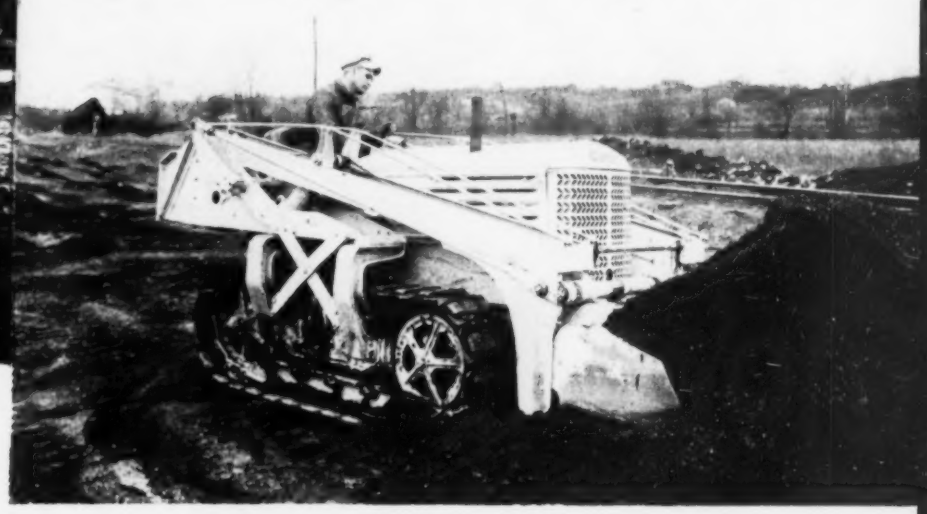
Cleveland, Ohio

One of the "musts" of winter is that roads must be kept open. Cletracs have the power and traction to buck their way through the deepest drifts. The smaller sizes make ideal sidewalk snow plows.

It takes power to haul out logs the size of these at Concrete, Washington. But Cletrac Diesels have it, plus the economy of operation and long life that make for profitable operation, even under the severest conditions.

Picking up ¾-yard at every bite, this Cletrac with front end loader is a quick, economical method of handling loose materials. A 6½-foot bulldozer blade replaces bucket for light backfilling and levelling.



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Crawler Tractors
Built To Endure

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Fifteen Models . . . 22 to 94 Horsepower

They'll do it *better!*

Don't skimp on lubrication. Running dry for only a few minutes can ruin a drill. When a drill is getting enough oil, it will show on the drill-rod shanks. Use Texaco, and be sure.

THEY'LL just naturally turn in a better day's work . . . put down more holes . . . and deeper holes . . . when they don't have to fuss with their drills.

The drills themselves will match . . . foot for foot . . . the capacity of the men . . . when lubricated with Texaco air-tool lubricants.

Whether your operations are dry or wet makes a big difference in the oil your drills should get.

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You can be sure of a big day's work . . . every day . . . for each drill, when it's on Texaco. And *this* is all anyone can expect of either his men or his drills.

Above all, don't attempt to save money on air-tool lubricants . . . you'll end by having to spend several times more than your "savings" on repairs.

Trained lubrication engineers are available for consultation on the selection and application of Texaco Petroleum Products. Prompt deliveries assured through 2020 warehouse plants throughout the United States. The Texas Company, 135 E. 42nd St., New York City.

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Just break the tube—don't even push the wires—and that's all there is to it.

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Atlas Accordion Fold Electric Blasting Caps were introduced in 1933. In three short years their convenience, safety and effectiveness have made them standard practise.

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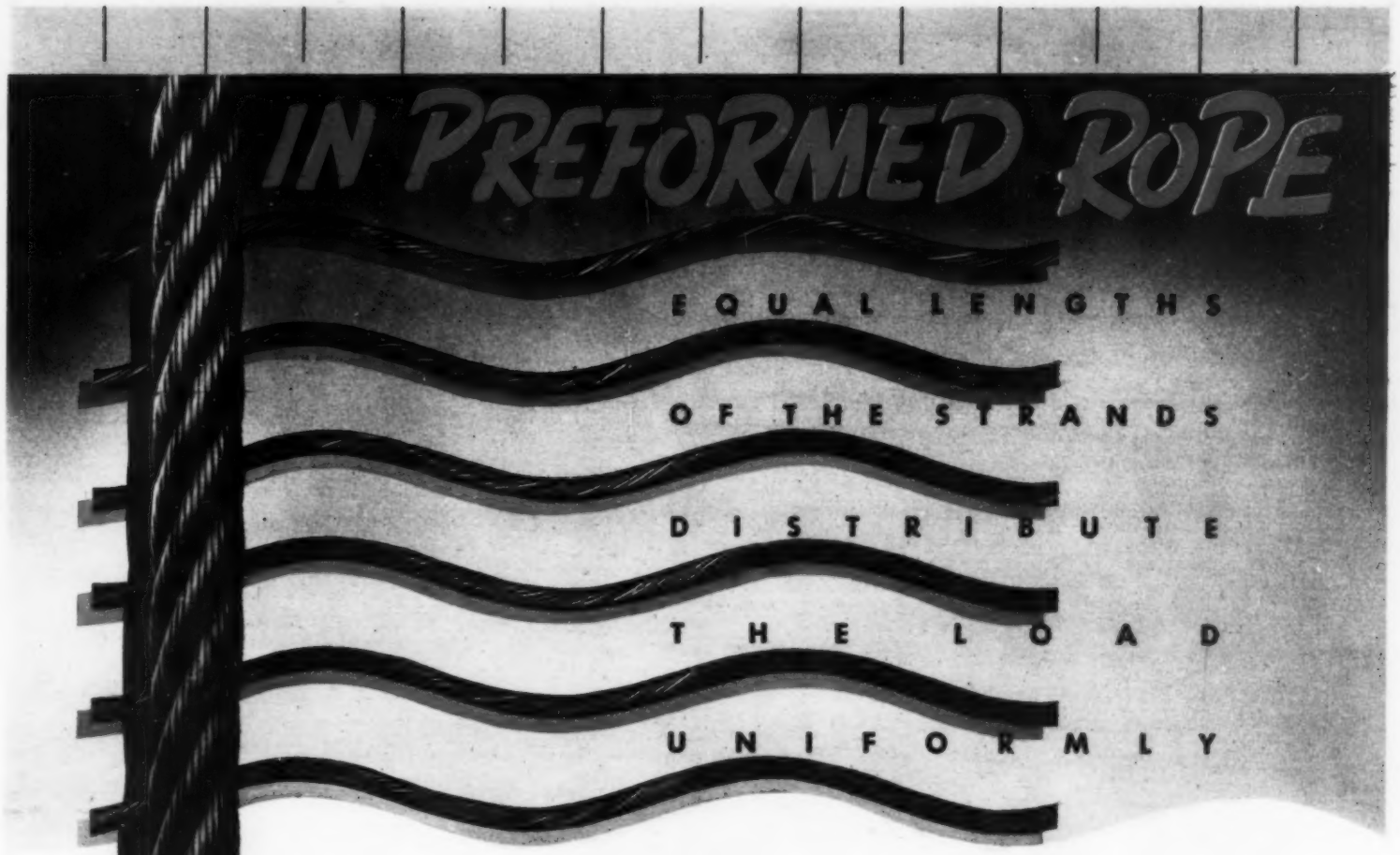
EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES



The very nature of the fabrication of Wisscolay Preformed Wire Rope automatically equalizes the lengths of the various strands. There are, therefore, no long drones nor short units that fail from overwork before their time. Every wire and strand assumes its equal share of the load. The resulting longer life of Preformed Wire Rope makes it a most economical rope. Practically all constructions can be made in Preformed. Tell us your use of wire rope and we will recommend the best Wisscolay Preformed for your purpose.

WICKWIRE SPENCER STEEL COMPANY, *General Offices:* 41 East 42nd Street, New York. *Sales Offices and Warehouses.* Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles; *Export Sales Dept.:* New York. WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

WIRE ROPE
by Wickwire Spencer

WICKWIRE SPENCER STEEL COMPANY
41 East 42nd Street, New York City

Please send me my free copy of your popular, new money saving manual, "Know Your Ropes."

Name_____

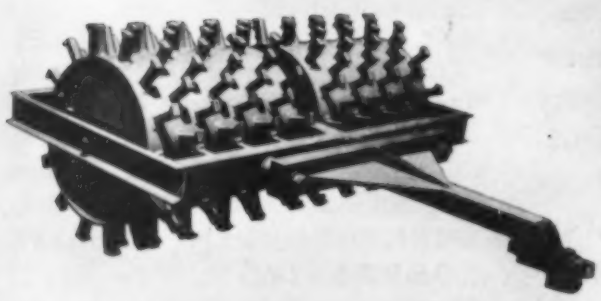
Firm_____

Address_____

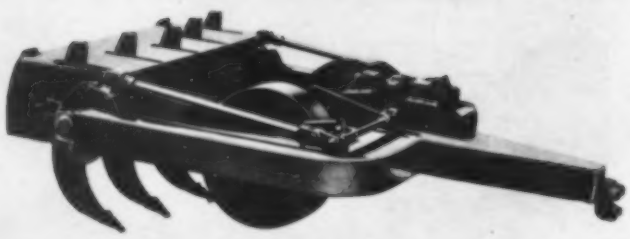
City_____ State_____

The New Leader

. . . in all-welded design



Southwest Tamping roller built in single drum, double drum and oscillating types.

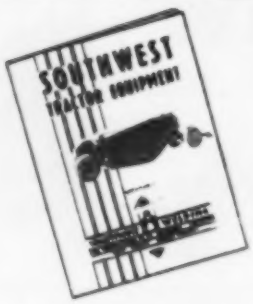


Southwest Self Cleaning Rotary Ripper.

The Southwest Carry Type Scraper is a fast acting, self dumping carrier Scraper. This Scraper is built in four sizes to meet the requirements of all types of tractors used in the cutting, filling, grading and finishing of jobs involving earth moving in large quantities.

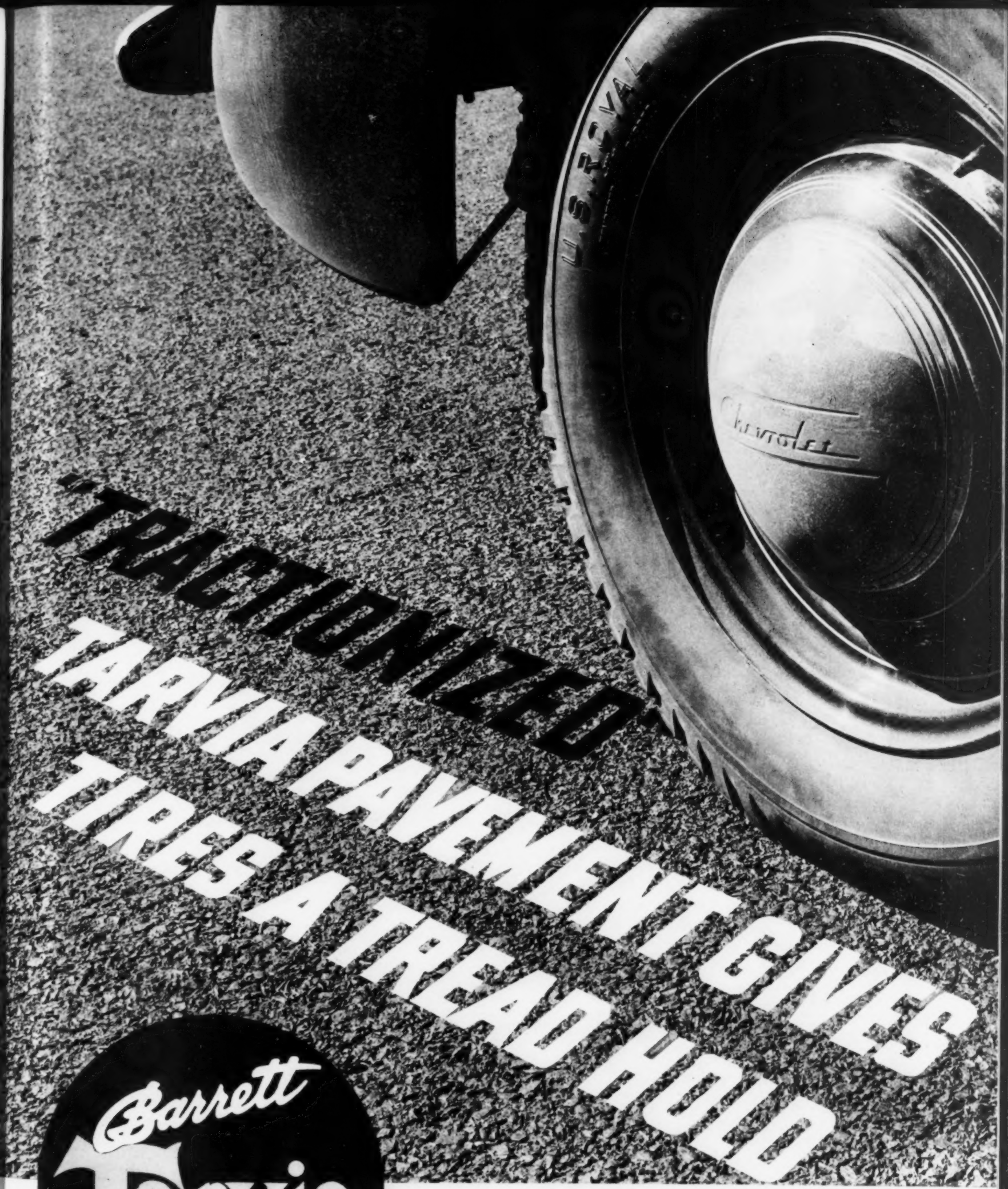
The Southwest Carry Type Scraper is the result of years of experience and experimenting with this type of equipment. It has been job proved and found to be efficient in operation on hauls comparable to any standard scraper. The simple cable operation of this unit provides a fast and efficient method of control. The unit is sturdily constructed of alloy steel electrically welded by the "Lucas Process" of Arc welding.

SOUTHWEST WELDING & MFG. CO., Inc.
ALHAMBRA • CALIFORNIA



New descriptive Bulletin with illustrations and specifications now available. Send for your copy.

SOUTHWEST
TRACTOR EQUIPMENT



Barrett

Tarvia

GOOD ROADS
AT LOW COST

THE BARRETT COMPANY New York Chicago Birmingham Boston Detroit Philadelphia Buffalo Lebanon Rochester Baltimore Minneapolis Cleveland Columbus Providence Toledo Youngstown Syracuse Hartford St. Louis Milwaukee Cincinnati Bethlehem Portland, Me. Norwood, N. Y. In Canada: THE BARRETT COMPANY, Ltd. Montreal Toronto Winnipeg Vancouver

KOEHRING Autocycle Paver

Koehring Paver stability **permits safe, "non-tip" pouring from shoulder to slab at approximately right angle —** ***long, full usable boom*** **assures maximum reach for concrete spreading —** ***free, oscillating boom*** **maintains vertical bucket suspension regardless of paver position —** ***Heavy Duty*** **construction guarantees necessary rigidity for shoulder to slab pouring.**

KOEHRING COMPANY

Pavers · Mixers · Shovels · Cranes · Draglines · Dumptors · Mud-Jacks

3026 WEST CONCORDIA AVENUE, MILWAUKEE, WISCONSIN

It Takes Balanced Skill to Reach the Heights

And to reach the pinnacle of popular acceptance at which "HERCULES" (Red-Strand) Wire Rope now stands, correct balance in all essential properties has played a major role. As each higher level of quality was attained during our eighty years of manufacturing experience, the vital characteristics—Strength, Toughness, Durability, Flexibility and Elasticity—have been raised to new high levels collectively * * * * all in balanced proportion.

"HERCULES" (Red-Strand) Wire Rope will deliver to you a new "high" in wire rope performance because it sets a new "high" in balanced wire rope construction.

Made Only By

A. Leschen & Sons Rope Co.

Established 1857

5909 Kennerly Avenue

ST. LOUIS, MO.

New York	90 West Street
Chicago	810 W. Washington Blvd.
Denver	1554 Wazee Street
San Francisco	520 Fourth Street
Portland	914 N. W. 14th Avenue
Seattle	2244 First Avenue South

SPEED MEANS SAVINGS

IN TUNNEL-DRIVING COSTS...

...and du Pont "Ventube" speeds up operations ... helps cut man-hours

LABOR is the biggest item in tunnel-driving costs. That's where "Ventube" saves money—by speeding work and reducing man-hours.

It takes very little time to suspend "Ventube" from its quickly strung support wires. When blasting, it can be withdrawn from the working face in a few minutes. After the blast, it can be thrown up to the working face to exhaust gases and permit a quicker return to work by the shift. "Ventube" was used on both the Los Angeles water supply project and the Twin Lakes project, where successive world's records were set for speed in tunnel-driving.

Jute "Ventube" is amazingly durable. It's built to stand up under the worst conditions encountered underground—acids, alkalis, fungus growth and other destructive agencies cannot harm it. It's made of extra-heavy, long-fibred Hessian cloth, *impregnated and coated* by a special process. There are no weak spots—it's as strong in tear resistance in the warp direction as in the filler.

Try a few sections of "Ventube" leading up to the working face and convince yourself of its strength and ease of handling.

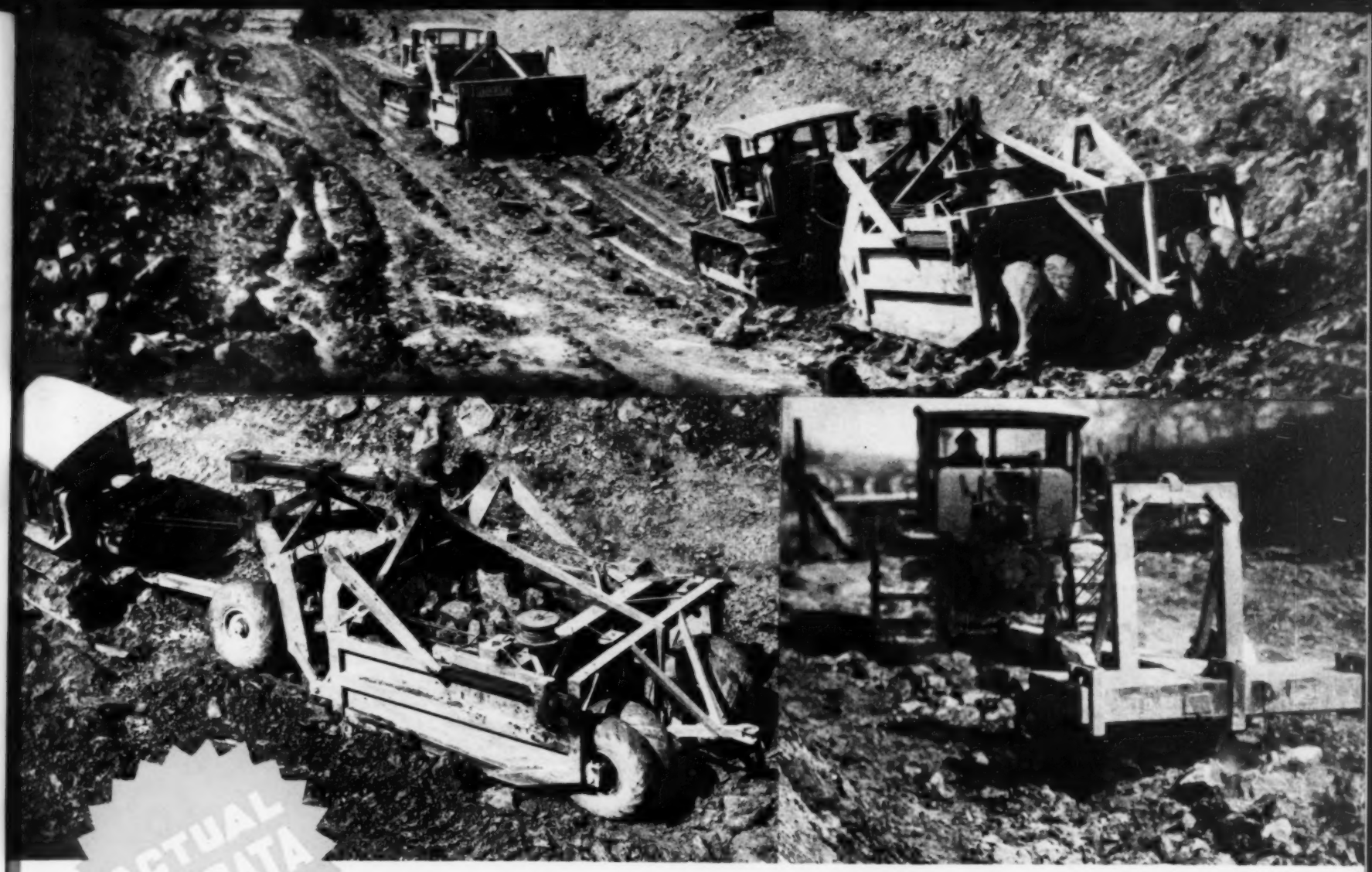
DU PONT

THE FLEXIBLE VENTUBE VENTILATING DUCT

REG. U.S. PAT. OFF.

E. I. DU PONT DE NEMOURS & CO., INC.

"FABRIKOID" DIVISION FAIRFIELD, CONNECTICUT



(Lower right) LeTourneau Heavy Duty Rooter using but one shank, tearing into Pennsylvania lime rock—apparently solid rock, but cleavage seams of clay enabled the Rooter to break it into chunks for Carryall loading (Lower Left) LeTourneau 12-Yard Carryall getting a bowl full of rock. (Top) Two LeTourneau Carryalls in the 61-foot cut.

ACTUAL JOB DATA

ROCKY GOING

but profitable . . . .

Lime rock—61 feet of it in this cut on a Pennsylvania realignment project, but Harrison Construction Company handled it all with LeTourneau equipment. The last 3 feet appeared to be solid rock, but a LeTourneau Heavy Duty Rooter ripped it into chunks, saved the expense and danger of blasting, enabled Carryall Scrapers to load with ease. Average round trip time for 1,100 feet with a 15% favorable grade was 6.5 minutes.

Such performance repeated on job after job has convinced Harrison Construction Company that almost all material short of solid rock is Scraper material, and has enabled them to consistently make rocky going profitable.

★ Gathered and certified by our Promotional Engineering Department. You are invited to call on this Department for aid in estimating and planning the best methods of handling your earthmoving problems.

Ask your "Caterpillar" tractor dealer to demonstrate what LeTourneau equipment can do on your job

LETOURNEAU

R. G. LeTOURNEAU, INC. • Peoria, Illinois • Stockton, California • Cable Address: "BOBLETORNO"

Manufacturers of: **Angledozers*, Buggies*, Bulldozers, Carryall* Scrapers, Cranes, Drag Scrapers, Power Control Units, Rooters*, Treedozers.**

* Name Registered U. S. Patent Office

BUILT FOR *Mounted*

STRONGER construction, wider gauge, ample power and lower operating costs explain why "Caterpillar" track-type Tractors are chosen for use with mounted equipment. They are designed and built to handle heavy, superimposed loads—a factor which recommends them for all kinds of jobs.

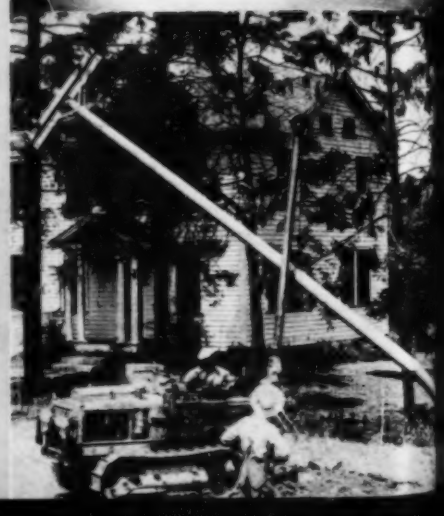
Your "Caterpillar" dealer can explain how the same qualities that enable these tractors to stand up under the strains of mounted equipment will bring *you* better performance. Get in touch with him.

ON THE JOB WITH A TRACTOR SHOVEL. Equipped with a Speeder Tractor Shovel attachment, this "Caterpillar" Diesel quickly moves on to the job, makes small as well as large jobs pay. On this road-building job in Georgia, it loaded 60 yards an hour —on one gallon of 6½-cent fuel per hour.

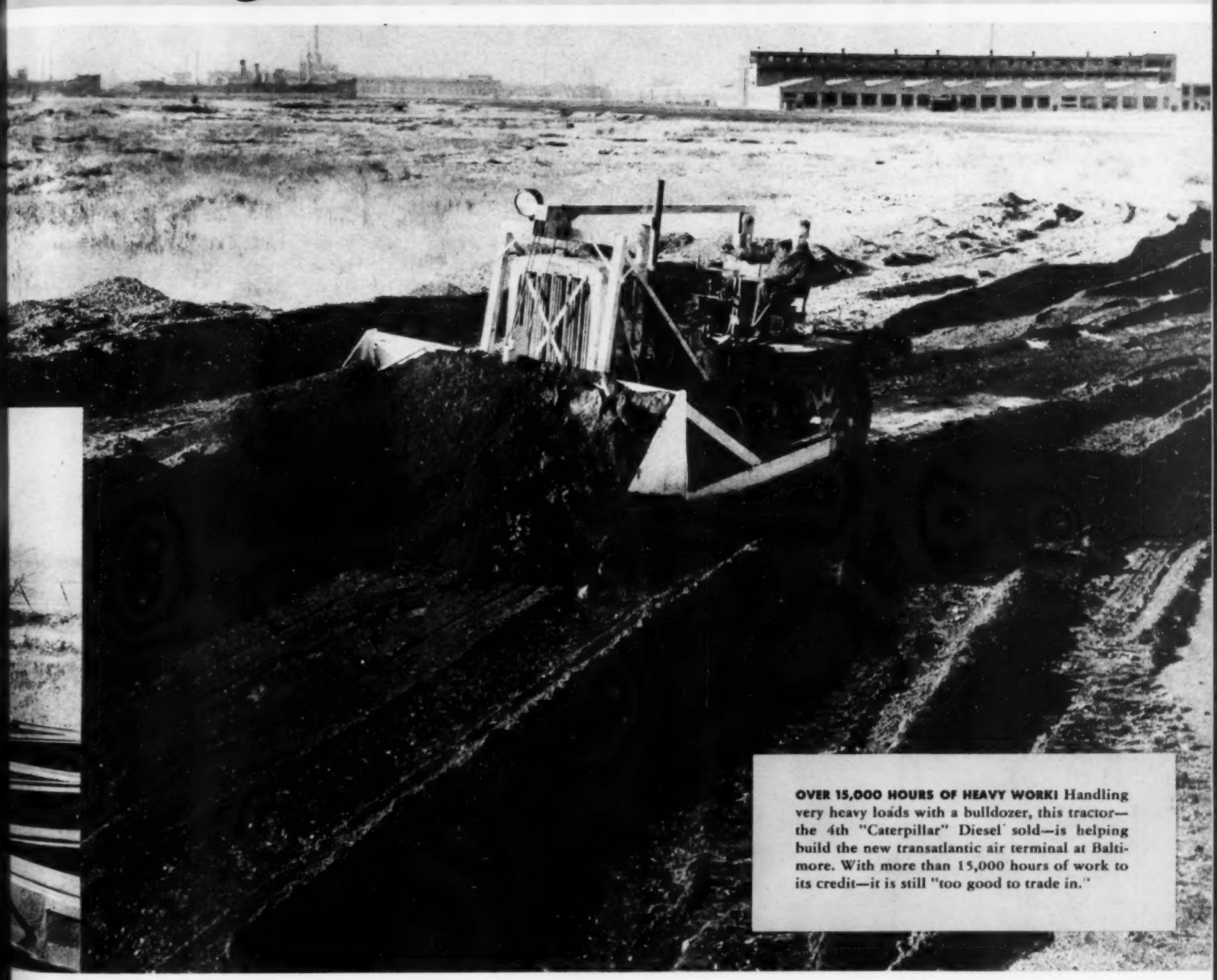
WELDING AND GRINDING WORN RAILS Mounted on this "Caterpillar" track-type Tractor is a Wilson Welder—and the tractor also operates a Hopley Electric Rail Surface Grinder. This unit is used for rail repairs. Traveling off the rails under its own power, it does not interfere with rail traffic.

HIGHWAY POST-HOLE DIGGER. This "Caterpillar" Twenty-Two is equipped with a Highway Post-hole Digger. It digs a 5-foot hole, sets the pole and moves on to the next location in 3 minutes! On the Northern Illinois Rural Electrification Project it has set 5000 poles in 700 hours.

ON THE JOB WITH CARDWELL SIDE BOOMS Wide-gauge "Caterpillar" Diesel Tractors permit working at a safe distance from the edge of excavations—accurate operation of boom controls. Shown laying 22-inch oil pipeline between Indianapolis and Detroit.



Equipment



OVER 15,000 HOURS OF HEAVY WORK! Handling very heavy loads with a bulldozer, this tractor—the 4th "Caterpillar" Diesel sold—is helping build the new transatlantic air terminal at Baltimore. With more than 15,000 hours of work to its credit—it is still "too good to trade in."

CATERPILLAR TRACTOR CO.
PEORIA, ILL.

REG. U.S. PAT. OFF.

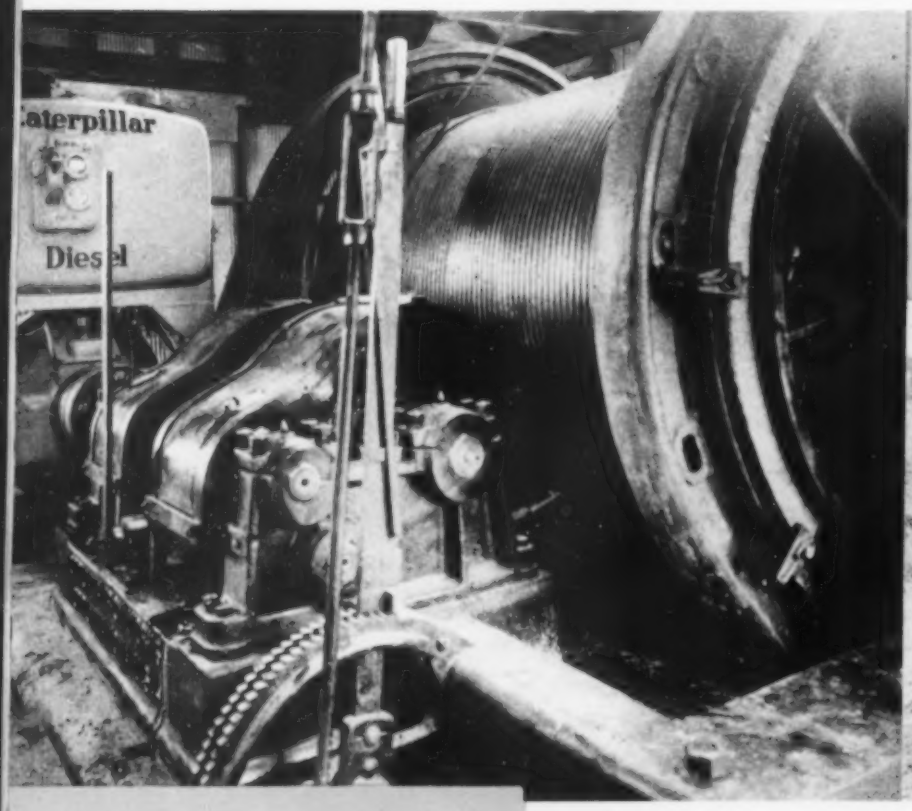
WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES,
TRACK-TYPE TRACTORS AND ROAD MACHINERY

BLASTING

AND POWER COSTS

AT THE RIGHT you see a Diesel-powered air compressor doing *two* jobs of blasting. One is obvious; the other is evident when the contractor checks his power bills. . . . He finds them smashed to a fraction of the cost of other types of power.

Low-priced fuel and expert engineering combine to give all classes of contractors and construction operators the economy and other advantages of Diesel power brought to a high state of efficiency by "Caterpillar." Put it on *your* jobs—earth moving, rock crushing, well drilling, ore hoisting, digging, dredging, pumping, pipe laying, sawing, grinding, milling, air compressing, current generating—driving machinery of any kind. . . . Then watch power costs go down! There's a dealer near you—or you can write us direct for literature or any special information or suggestions pertaining to your particular needs.



OTTUMWA MINE HOIST BRINGS UP FLUORSPAR IN KENTUCKY On Klondike Fluorspar Co. operations near Marion. Power costs have tumbled since "Caterpillar" Diesel Engines were installed to drive hoists, air-compressors and other equipment.

AN OSGOOD MAKES GOOD IN PANAMA. A "Caterpillar" Diesel D13000 Engine operates this 1½-yard shovel (Victor MV Model) on constant clean-up jobs necessary in the Canal Zone.

7 ENGINE SIZES

D17000	8 cyl.	160 hp.
D13000	6 cyl.	125 hp.
D11000	6 cyl.	100 hp.
D8800	4 cyl.	80 hp.
D7700	4 cyl.	66 hp.
D6600	3 cyl.	60 hp.
D4400	4 cyl.	44 hp.

CATERPILLAR

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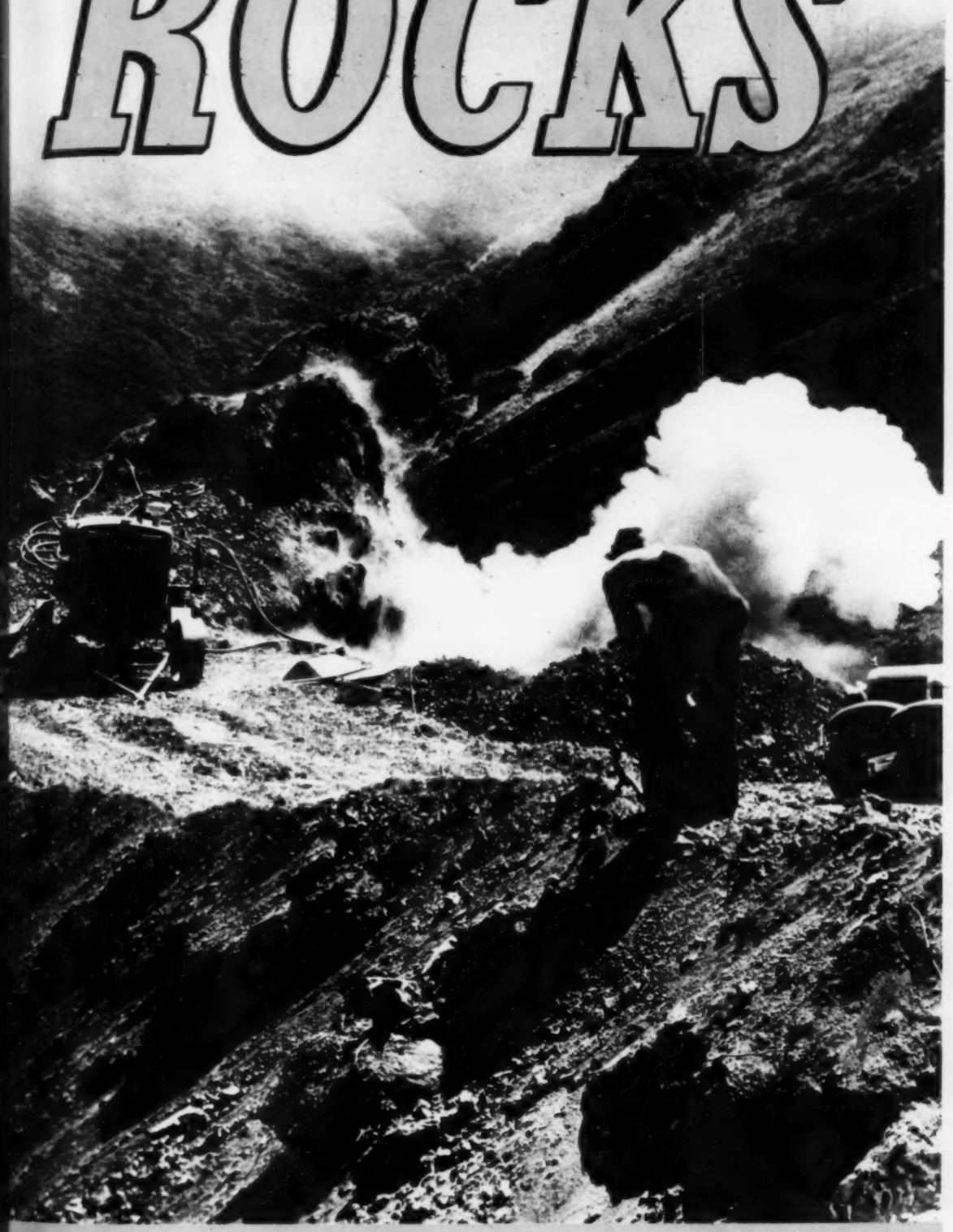
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

WORLD'S

ROCKS



GARDNER-DENVER AIR-COMPRESSOR ON A FAMOUS JOB. Powered by a "Caterpillar" D11000 drilling holes for blasting charges on the Macco Construction Co. contract on the Golden Gate Bridge approach. Fast going at minimum power cost.

83 LEADING MANUFACTURERS POWER THEIR PRODUCTS WITH "CATERPILLAR" DIESEL ENGINES

Acme Road Machinery Co.	Frankfort, N. Y.
Allsteel Products Mfg. Co.	Wichita, Kans.
American Hoist & Derrick Co.	St. Paul, Minn.
American Steel & Wire Co.	Worcester, Mass.
Bay City Shovels, Inc.	Bay City, Mich.
Berger Engineering Works, Inc.	Seattle, Wash.
Bodinson Manufacturing Co.	San Francisco, Calif.
Brookville Locomotive Co.	Brookville, Pa.
The Browning Crane & Shovel Co.	Cleveland, Ohio
The Buckeye Traction Ditcher Co.	Findlay, Ohio
Bucyrus-Erie Co.	South Milwaukee, Wis.
Buffalo Springfield Roller Co.	Springfield, Ohio
Buhl Co., The	Chicago, Ill.
Byers Machine Co., The	Ravenna, Ohio
Canadian Sullivan Machinery Co., Ltd.	Dundas, Ontario, Canada
Chase Turbine Co.	Orange, Mass.
Chicago Pneumatic Tool Co.	Franklin, Pa.
Clark Machinery Co.	Wichita Falls, Tex.
Clyde Iron Works, Inc.	Duluth, Minn.
Cook, Inc., A. D.	Lawrenceburg, Ind.
Cunningham Machinery Corp.	Shreveport, La.
Davenport Besler Corp.	Davenport, Iowa
Davey Compressor Co., Inc.	Kent, Ohio
Diamond Iron Works, Inc.	Minneapolis, Minn.
Dominion Hoist & Shovel Co., Ltd.	Montreal, Que., Canada
Emsco Derrick & Equipment Co.	Los Angeles, Calif.
Fate-Root-Heath Co., The	Plymouth, Ohio
Frick Co., The	Waynesboro, Pa.
Gardner-Denver Co. (Canada) Ltd.,	Toronto, Ontario, Canada
Gardner-Denver Company	Quincy, Ill.
Georgia Iron Works	Augusta, Ga.
Gruendler Crusher & Pulverizer Co.	St. Louis, Mo.
Gullet Gin Company	Amite, La.
Hardie Manufacturing Co.	Hudson, Mich.
Harmon, Alfred	Melbourne, Australia
Harnischfeger Corp.	Milwaukee, Wis.
Hendy Iron Works, Joshua	San Francisco, Calif.
Hopper Machine Works	Bakersfield, Calif.
Hug Company, The	Highland, Ill.
Industrial Brownhurst Corp.	Bay City, Mich.
Iowa Manufacturing Co.	Cedar Rapids, Ia.
Junior Monarch Hay Press	San Leandro, Calif.
Kinney Manufacturing Co.	Boston, Mass.
Koehring Company	Milwaukee, Wis.
LeRoi Company	Milwaukee, Wis.
Lima Locomotive Works, Inc.	Lima, Ohio
Link-Belt Company	Chicago, Ill.
Manitowoc Engineering Works	Manitowoc, Wis.
Marion Steam Shovel Co., The	Marion, Ohio
Midwest Locomotive Works	Hamilton, Ohio
Mission Manufacturing Co.	Houston, Tex.
Morris Machine Works	Baldwinsville, N. Y.
Mundy Hoisting Engine Co., J. W.	Elizabeth, N. J.
Novo Engine Company	Lansing, Mich.
Oil Well Supply Co.	Dallas, Texas
Orton Crane & Shovel Co.	Huntington, Ind.
Osgood Company, The	Marion, Ohio
Ottumwa Iron Works	Ottumwa, Iowa
Pacific Placers Engineering Co.	Los Angeles, Calif.
Parsons Company, The	Newton, Iowa
Pioneer Gravel Equipment Mfg. Co.	Minneapolis, Minn.
Pomona Pump Company	Pomona, Calif.
Puget Sound Machinery Depot	Seattle, Wash.
Randolph Company, O. W.	Toledo, Ohio
Sauerman Bros., Inc.	Chicago, Ill.
Schramm, Inc.	West Chester, Pa.
Speeder Machinery Corp.	Cedar Rapids, Iowa
Standard Steel Works	Los Angeles, Calif.
Sterling Pump Corp.	South Bend, Ind.
Sullivan Machinery Co.	Michigan City, Ind.
Thew Shovel Co., The	Lorain, Ohio
Traylor Engineering & Mfg. Co.	Allentown, Pa.
Unit Rig & Equipment Co.	Tulsa, Okla.
Universal Crusher Co.	Cedar Rapids, Iowa
Universal Power Shovel Corp.	Milwaukee, Wis.
Vilter Manufacturing Co., The	Milwaukee, Wis.
Vulcan Iron Works	Wilkes-Barre, Pa.
Washington Iron Works	Seattle, Wash.
Western Knapp Engineering Co.	San Francisco, Calif.
Wheatley Bros. Pump & Valve Mfg. Co.	Tulsa, Okla.
Whitcomb Locomotive Co., The	Rochelle, Ill.
Wilson Manufacturing Co.	Wichita Falls, Texas
Worthington Pump & Machinery Corp.	Harrison, N. J.

DIESEL ENGINES

LARGEST MANUFACTURER OF DIESEL ENGINES

PILE IT HIGH!

THE LaPLANT-CHOATE RUBBER WHEELED WAGON CAN TAKE IT!

19 YARDS CAPACITY
ALSO AVAILABLE IN 13-YARDS SIZE

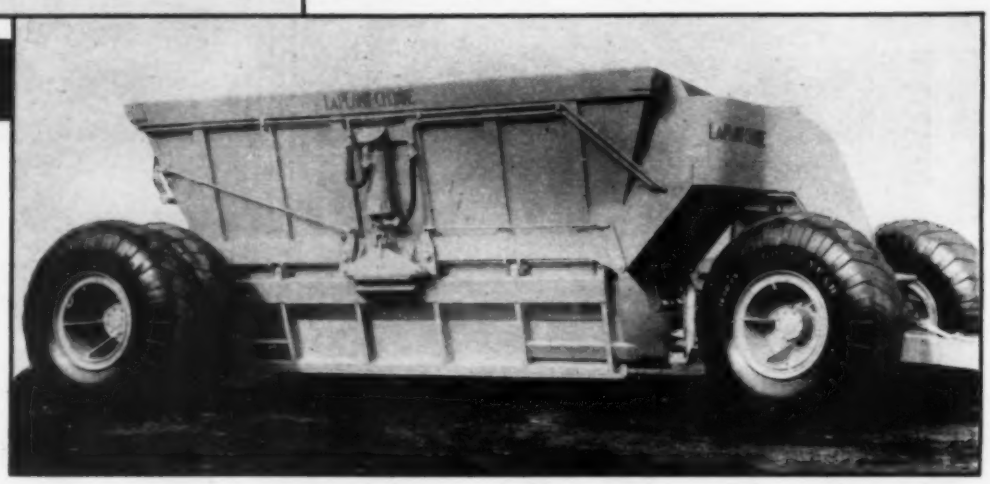
For Use With "Caterpillar" Track-Type Tractors Exclusively

SHORT TURNING

Because of the full cut under swing of the front wheels on these wagons they literally turn inside out. They not only turn shorter than other types of wagons but they turn easier because they do not pivot on wheels or tracks as do cart-type wagons. Make your short cut turns to greater profits with these wagons.

EASY DUMPING

One-man hydraulic control insures easy operation of outside-hinged doors. No inside obstructions. Stickiest loads dump instantly. These wide-top wagons are quickly spotted and loaded. They roll easily and negotiate soft places same as track-type wagons . . . but much faster and with less draft.



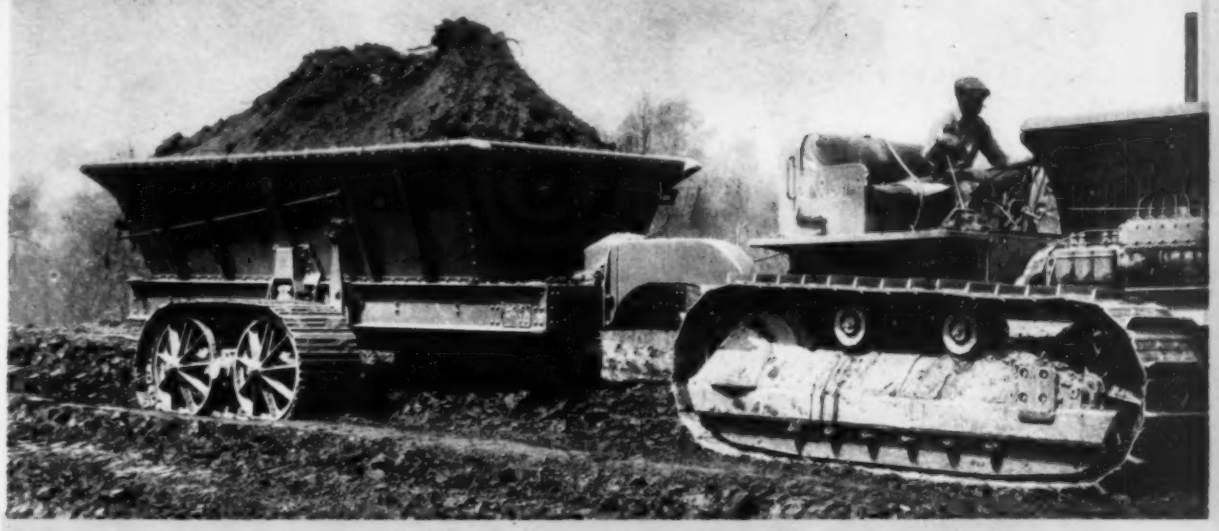
BULLDOZERS • SCRAPERS • TAMPING ROLLERS • ROAD BUILDERS • BRUSH CUTTERS • SNOW PLOWS

LaPlant-Choate Mfg. Co. Inc.
CEDAR RAPIDS, IOWA

BIGGER LOADS EVERY TRIP
BIGGER PROFITS EVERY JOB

WITH

ATHEY FORGED-TRAK 18-YARD *BOTTOM DUMP TRAILERS*



EASIER-RUNNING
All-Weather
ATHEY FORGED-TRAK WHEELS

BRIDGE THE LOW SPOTS

CLIMB OBSTRUCTIONS

LOWER YOUR HAULING COSTS

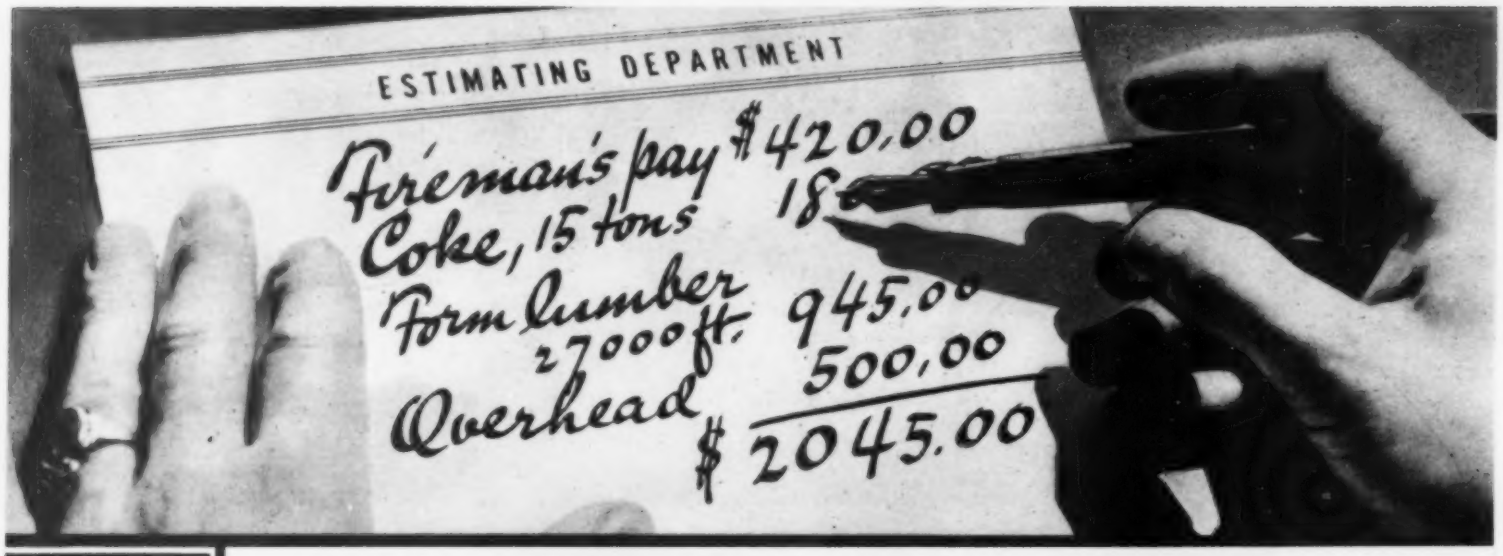
ATHEY
Forged-Trak
(REG. TRADE-MARK)

● It's simple as A-B-C to figure out why these husky new hauling units will lower YOUR hauling costs. Eighteen-yard capacities mean bigger loads moved at every trip . . . fewer trips . . . faster schedules. And those 30-ton Athey Forged-Trak Wheels assure *all-weather* operation . .. no "hold-ups" . . . none of the delays of "fair-weather" hauling equipment. For easier . . . less expensive . . . more profitable hauling, use Athey Forged-Trak Bottom Dump Trailers with "Caterpillar" Diesel Tractors. See your "Caterpillar" Dealer—or write to us.

ATHEY TRUSS WHEEL CO.
5631 West 65th Street • Chicago, Illinois
CABLE ADDRESS: "TRUSSWHEEL", CHICAGO

BOTTOM DUMP TRAILERS

CAPACITIES FROM 5 TO 18 YARDS



90 DAYS GAINED
Contractor Saved $2045.00

Minnesota State Feeble-Minded School, Faribault, Minn.; Contractor, Dean Construction Co., Minneapolis, Minn.; Architect, Ray R. Gauger Co., St. Paul, Minn.

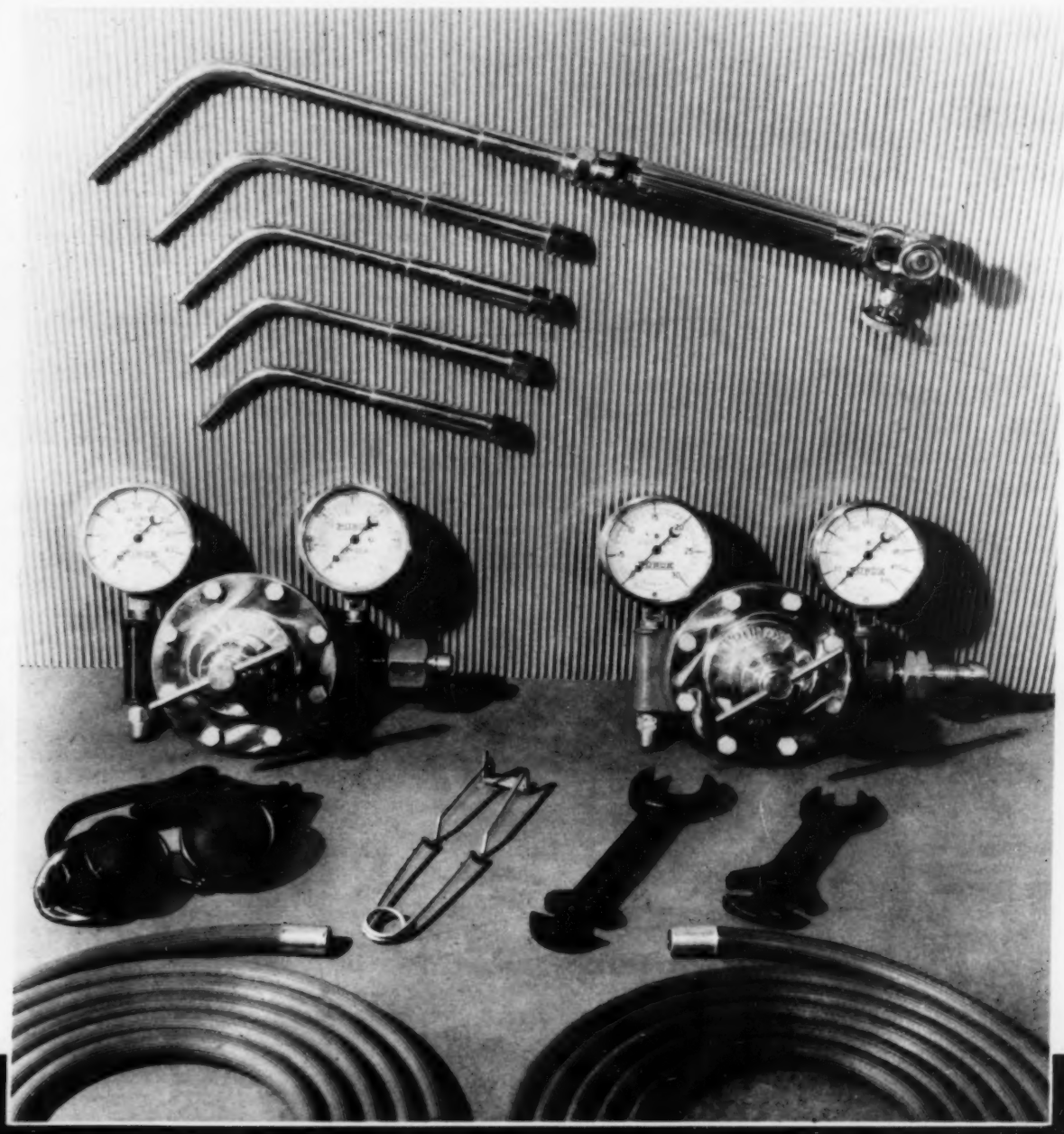
A typical story of the advantages of Lehigh Early Strength Cement. Entire operation was completed 90 days ahead of schedule because the usual waiting time for concrete to cure and harden was reduced by using Lehigh Early Strength Cement instead of normal portland cement.

Forms were removed in one-quarter the usual time and the contractor made large savings—reduced heat curing costs, less form lumber required, reduced overhead expense—a total saving of $2045.00. Under any conditions, compared to normal portland cement, Lehigh Early Strength Cement makes concrete of equal strength three to five times as fast. Informative literature will be gladly sent—it may suggest how you may save time and money on concrete operations.

LEHIGH PORTLAND CEMENT COMPANY, ALLENTOWN, PA., CHICAGO, ILL., SPOKANE, WASH.

LEHIGH EARLY STRENGTH CEMENT

READY *for any Welding Job*



PRODUCTS OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

PUROX* NO. 4012 *Oxy-Acetylene Welding Outfit*

Complete . . . $82.00

THIS standard Purox outfit can help you increase your earning power through its efficiency, economy and long life. It includes Purox Heavy Duty Oxygen and Acetylene Regulators and the smoothly performing No. 35 Welding Torch. Have your Purox jobber show you the many unique features of this outfit and other Purox equipment.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

New York and Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

PUROX

WELDING AND CUTTING APPARATUS AND SUPPLIES

*Trade-Mark

A·W HYDRAUL

ACCURATE CONTROL:
Where successful operation depends on accuracy of control, Austin-Western hydraulic equipment does an outstanding job. Adjustments as close as a quarter of an inch are easily made.

INSTANT RESPONSE:
No lag—no lost motion. Makes big equipment handle easily.

Hydraulic vs. Mechanical Power

57 parts or points are subject to wear when one side of the blade of a mechanically powered road grader is lifted. For each additional movement 44 more points or parts are called into play; bevel gears, universal joints, jaw clutches, etc., are costly to replace, and the lost motion that must exist to permit operation, steadily increases as these parts wear.

For the same operation hydraulic controls have only 15 wearing points or parts and these are subject to far less wear. For each additional movement only 6 more parts or points are involved.

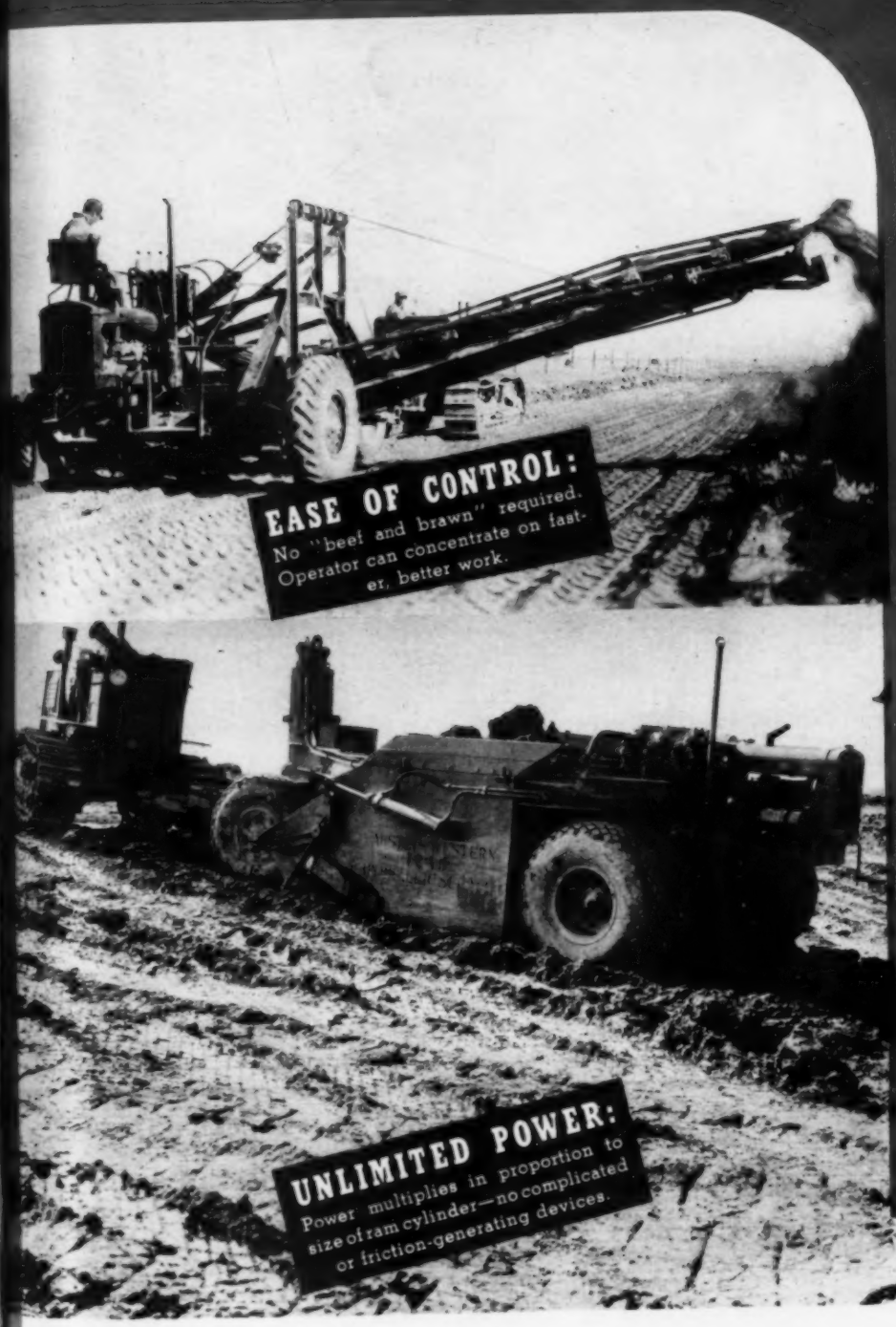
Smooth, fast, positive action is the result when machines are equipped with Austin-Western hydraulic control.

UNYIELDING RIGIDITY:
Holds working part in vise-like grip. Greater precision in work. Eliminates lost motion and play.

The Austin-Western Road

LIC CONTROLS

built to make these dirt movers *outperform*


EASE OF CONTROL:
No "beef and brawn" required. Operator can concentrate on faster, better work.
UNLIMITED POWER:
Power multiplies in proportion to size of ram cylinder—no complicated or friction-generating devices.

WHEREVER high operating efficiency calls for a combination of power, speed, and accurate adjustments, Austin-Western specifies hydraulic controls.

Experience has shown that the positive action and ease of operation which these simplified controls make possible are an important reason for Austin-Western's acknowledged leadership in the earth moving and road building industry.

Hydraulic Controls give you all the power you need where and when you want it. They give you instant response—no lost motion or lag due to wear in gears and pinions; and the moment the control is in neutral it locks immovably, resisting every blow or shock.

Introduced in the motor grader five years ago, hydraulic controls are now used in practically every machine that Austin-Western builds.

Their value to the owner has been proved in use and their economy of operation and maintenance are acknowledged by contractors and public officials everywhere.

Ask us to prove their superiority. The coupon brings you complete information.

AUSTIN-WESTERN ROAD MACHINERY CO.
A-6, Aurora, Illinois

☐ Send me a salesman.
Tell me more about:

- ☐ Hydraulic Controls
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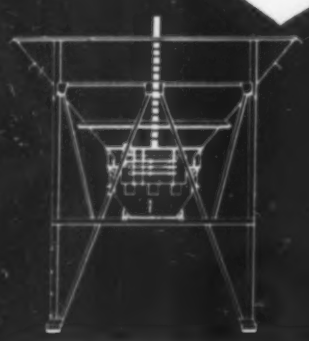
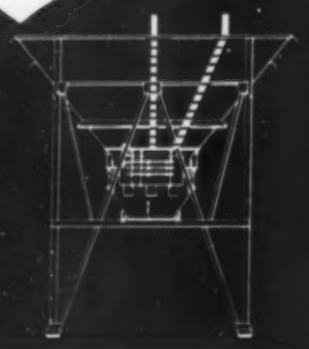
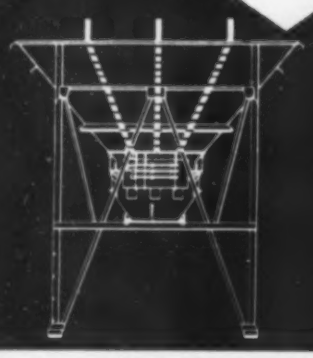


ON YOUR NEXT JOB YOU CAN CONVERT TO A 3 COMPARTMENT BIN LIKE THIS.

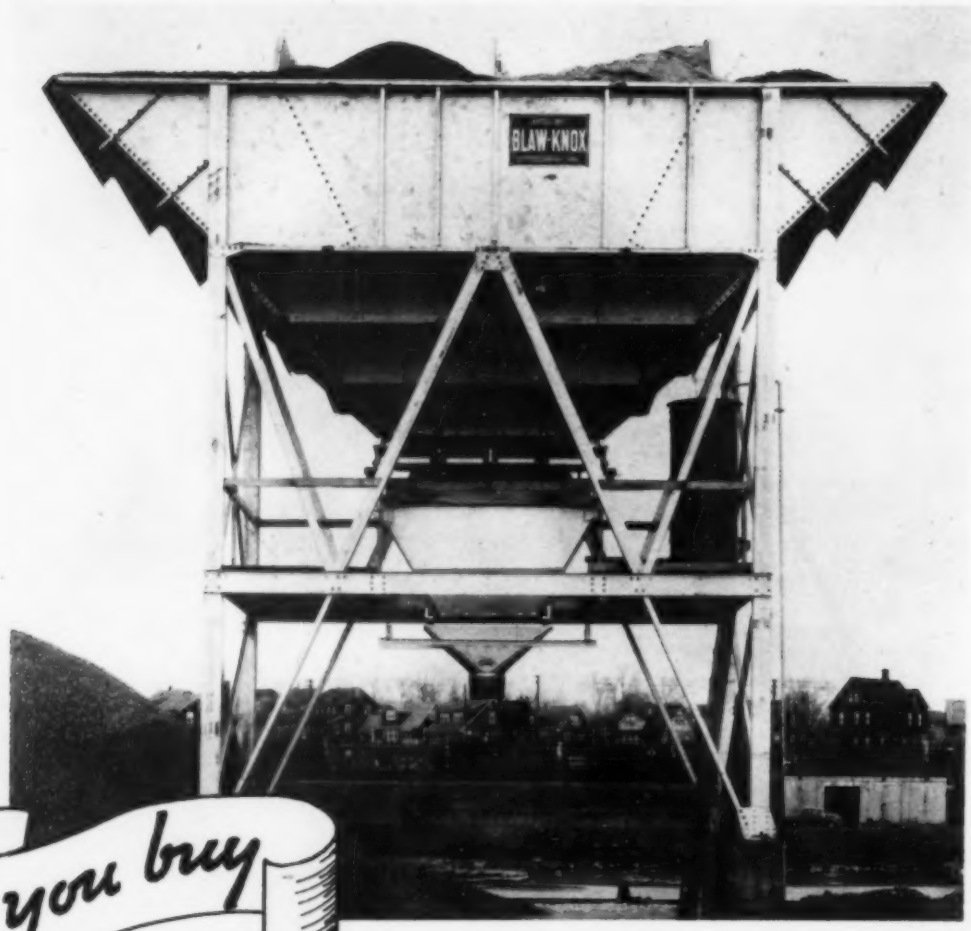


. . . OR A 4 COMPARTMENT BIN LIKE THIS . . .



THE ORIGINAL BIN DESIGN PROVIDES FOR THESE CONVERSIONS TO BE MADE RAPIDLY AND ECONOMICALLY

IN BLAW-KNOX BATCHERPLANTS



you buy

VERSATILITY

Look ahead when you buy a bin and batcher, beyond your present job. Buy a *versatile* Blaw-Knox BATCHERPLANT—convertible to varying needs and specifications—to use on many jobs.

As your requirements change, add bin bulkheads at slight extra cost to suit your aggregate specifications.

The Weighing Batcher you buy originally is designed to accommodate extra weighing beams to meet these changing conditions, the cost of extra weighing beams is nominal.

Only at Blaw-Knox can you buy this changeability in a standard, shipped from stock, Batcherplant—with the added features of self-cleaning bin design; ease of erection; accurate, simple and dependable weighing batchers—and rugged construction to last through a number of jobs.

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P&H MODEL 855 2-YD.
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New Heavy-Duty Machines with Faster Digging Cycles

Here, modern engineering is carried further than ever before in an excavator. The new 855 and 955 combine the lightness and strength of new alloy steels with a more scientific distribution of weight to reduce unnecessary dead weight and step-up operating speeds.

1. LIGHTER—STRONGER—with all-welded construction of new high-tensile steels; makes possible faster operating speeds.
2. LARGER CLUTCHES, BRAKES, AND DRUMS, for heavy-duty work, to withstand the abuse of continuous high-speed operation.
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4. LIVE BOOM, adjusts quickly to any digging angle; eliminates waste time in raising and lowering the boom.
5. DIESEL POWER, for heavier lugging ability; freedom from motor stalling, lower operating costs.
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Get the whole story on faster production at lower costs with these new excavators. For bulletins write Harnischfeger Corp.

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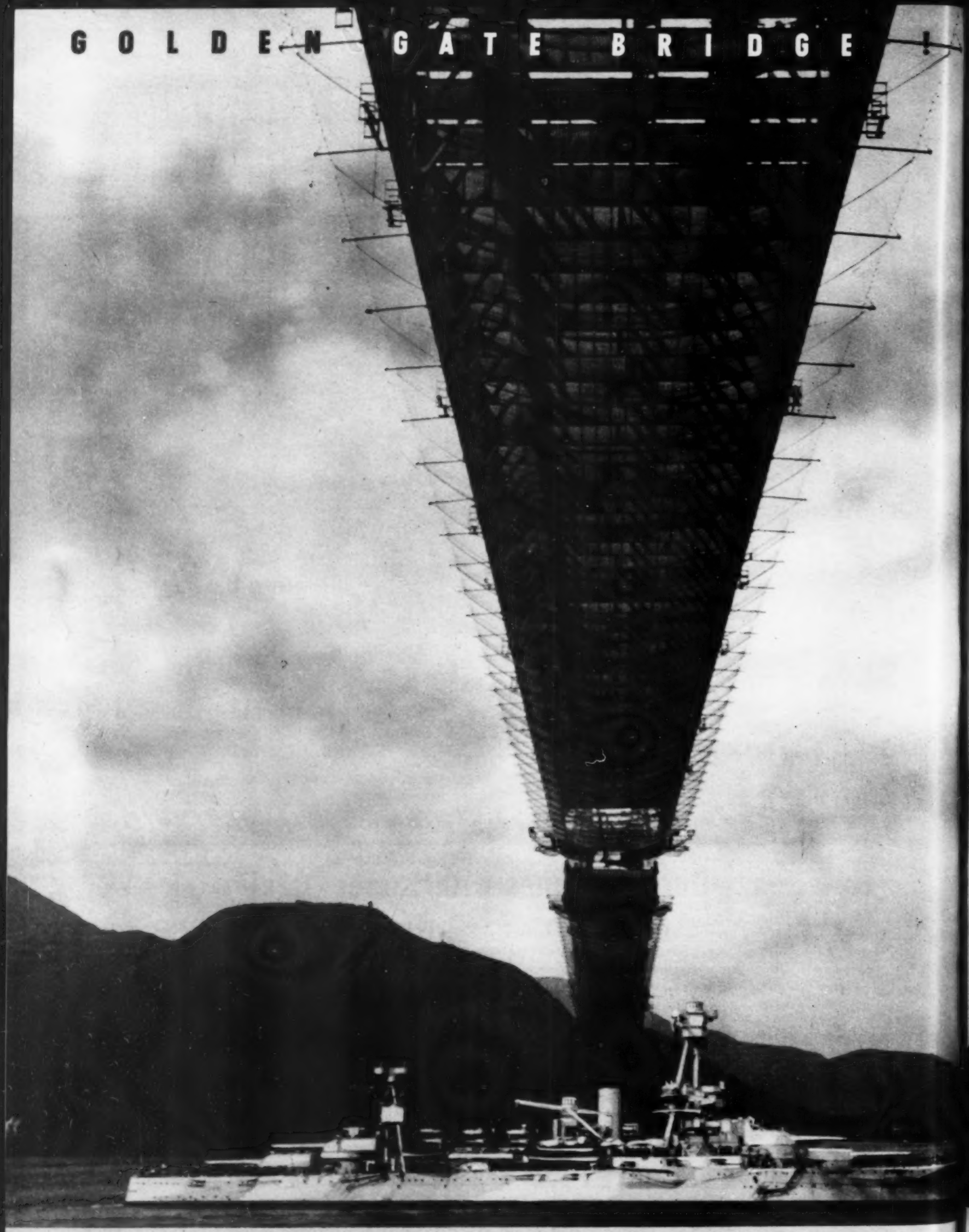
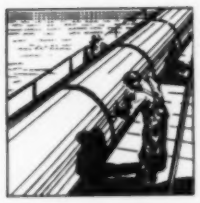


80,000 MILES OF ROEBLING WIRE USED IN MAIN CABLES

MAIN CABLES COULD SUPPORT

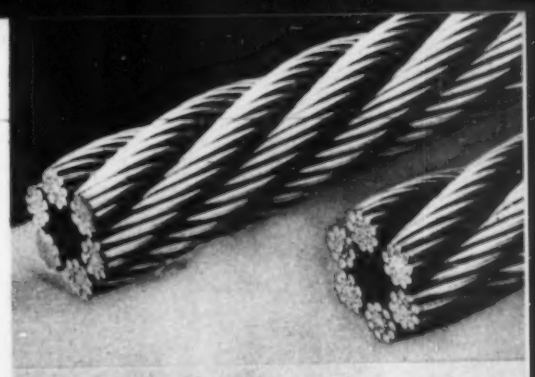
SEVEN 27,000 TON BATTLESHIPS



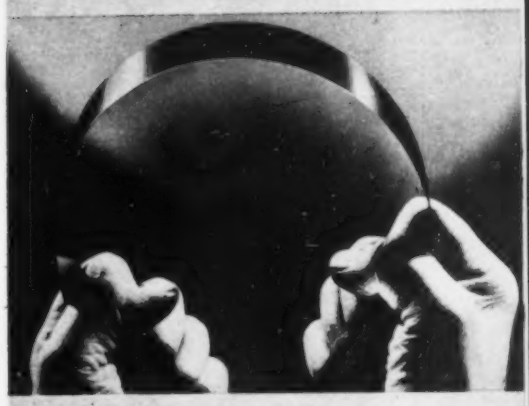
Passing under the superstructure of San Francisco's new and already renowned Golden Gate Bridge is the huge U. S. S. New York . . . 27,000 tons displacement. Seven such battleships could be supported by the combined strength of the two main bridge cables. ● Spun by Roebling in record time, these cables each weigh 2850 lbs. per lineal foot. Cross-sectional metallic area of each cable: 830 square inches. Each contains 27,572 individual wires 0.196 inches in diameter. The longest and largest suspension bridge cables in existence, they contain a total of 80,000 miles of Roebling Open Hearth Acid Steel Wire . . . 22,000 tons! ● John A. Roebling's Sons Co., Trenton, N. J. Branches in Principal Cities.

CABLES SPUN BY

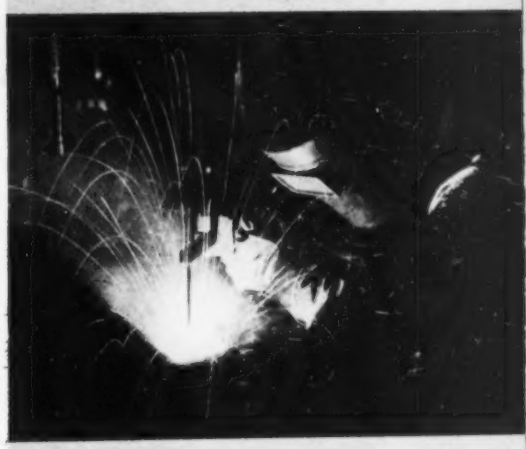
ROEBLING



WIRE ROPE

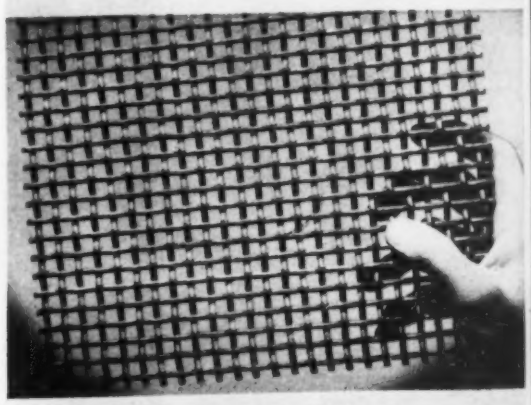


FLAT WIRE



WELDING WIRE

ELECTRIC WIRE



WIRE FABRIC

TRUCK operating records show that it is false economy—*deliberately wasteful*—to overburden lighter trucks with crushing loads. Only engineered-for-the-job trucks, of which GMC's are admittedly the leaders, can handle the heavier loads with positive assurance of minimum-cost operation . . . GMC trucks are built with extra safety factors—stouter frame, multi-leaved springs, husky axles and bearings to shoulder heavy loads—yet there's not one pound of superfluous weight to carry around at the expense of gas and tires . . . As for power and downright pulling ability, the ratio of GMC's torque to chassis weight (proved in published comparisons) exceeds competition! . . . The expansive GMC line (½ to 12 tons) was laid out so you could choose a truck with the ideal combination of size, power and equipment to exactly fit your haulage problems. See GMC.

QUALITY AT PRICES LOWER THAN AVERAGE

Time payments through our own Y. M. A. C. Plan at lowest available rates

GENERAL MOTORS TRUCKS & TRAILERS

GENERAL MOTORS TRUCK & COACH
DIVISION OF
YELLOW TRUCK & COACH MANUFACTURING COMPANY, PONTIAC, MICHIGAN

QUALITY *Construction*
MAKES THE DIFFERENCE

MODEL "K-O" 54 SPEED PATROL
WITH CONTROLLED IGNITION OIL ENGINE

Allis-Chalmers Speed Patrols give you quality features and advantages found in no other motor grader. One example is their all-bolted construction—with no rivets, no welds and no lock washers. Alloy steel "stretch-proof" bolts and high, double-thickness nuts prolong the life of the frame and reduce maintenance. The heavy-duty frame is cross-braced at seven points for strength and rigidity. The wide 64-inch circle has double to triple the usual guide area and holds the blade firmly under all conditions. Proper balance between power, weight, speed and traction means more and better work—A-C Speed Patrols convert a higher percentage of their weight into blade pressure than any other motor graders. This is because of their long wheel base, extra long blade base and center engine mounting—and is vitally essential to effective work. Other Speed Patrol advantages include their correct speeds—up to 10 M.P.H.... complete wear take-up ... positive traction ... dependable controls ... and powerful, smooth-running, heavy duty engines that have proved themselves in Allis-Chalmers tractors. The Controlled Ignition Oil Engine gives you instant starting and reduced maintenance on Diesel fuel oil. Ask the Allis-Chalmers dealer.

... INVESTIGATE

ALLIS-CHALMERS SPEED PATROLS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

Open gears *need* the protection of GULF LUBCOTE

. . . a heavy bodied lubricant with remarkable adhesiveness and lasting qualities

HERE is a special petroleum lubricant which is solving gear lubrication problems for many contractors. Gulf Lubcote combines exceptionally high adhesiveness for metal surfaces with natural high viscosity and efficient lubricating qualities for specific requirements.

Gulf Lubcote effectively cushions gear teeth and resists the wiping action of gears in motion. It retains its original fluidity and high lubricating qualities to a remarkable degree, resisting heat and decomposition.

Use Gulf Lubcote to lengthen the life of gears on your shovels and other equipment. You will be pleased with the results.

FOUR REASONS . . . WHY GULF LUBCOTE IS THE LUBRICANT OF UNPARALLELED QUALITY FOR OPEN GEARS

1 GULF LUBCOTES are heavy bodied products especially manufactured to have the requisite property of high adhesiveness for metal surfaces necessary in lubricants for open gears.

2 Due to selected crudes used and to the process of refinement employed, GULF LUBCOTES possess unusual lubricating qualities together with the essential property of flowing with the movement of the gear and pinion teeth.

3 The lubricating film provided by GULF LUBCOTES, in addition to being impervious to moisture, acid fumes and gases, will withstand extreme temperature changes without deterioration.

4 Due to the tough and tenacious nature of GULF LUBCOTES they will effectively reduce objectionable gear noise and at the same time will provide maximum protection against corrosion, pitting or excessive wear of the gear teeth.

GULF OIL CORPORATION

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GENERAL OFFICES: GULF BLDG., PITTSBURGH, PA.

GULF INDUSTRIAL LUBRICATION

"IT IS THE BEST OPERATING SHOVEL ENGINE WE HAVE EVER USED"

Mr. R. P. Meehan,
Cummins Diesel Sales Corp.,
1145 Harrison St.,
San Francisco, Calif.

April 7, 1937

Dear Sir:

We repowered our Osgood yard and a quarter shovel with one of your Model HI 6 cylinder Cummins Diesel Engines nearly a year ago. This shovel worked at 6400 feet altitude in the mountains above Truckee for several months and even at that altitude it has started instantly at all times.

It has been run about 2500 hours and we can honestly say that we nave had no trouble at all and have given it only ordinary routine servicing.

Its instant response to the throttle has been a revelation to us and we know that it is the best operating shovel engine we ever used.

Yours very truly,

J R Reeves
General Contractor
Sacramento, California

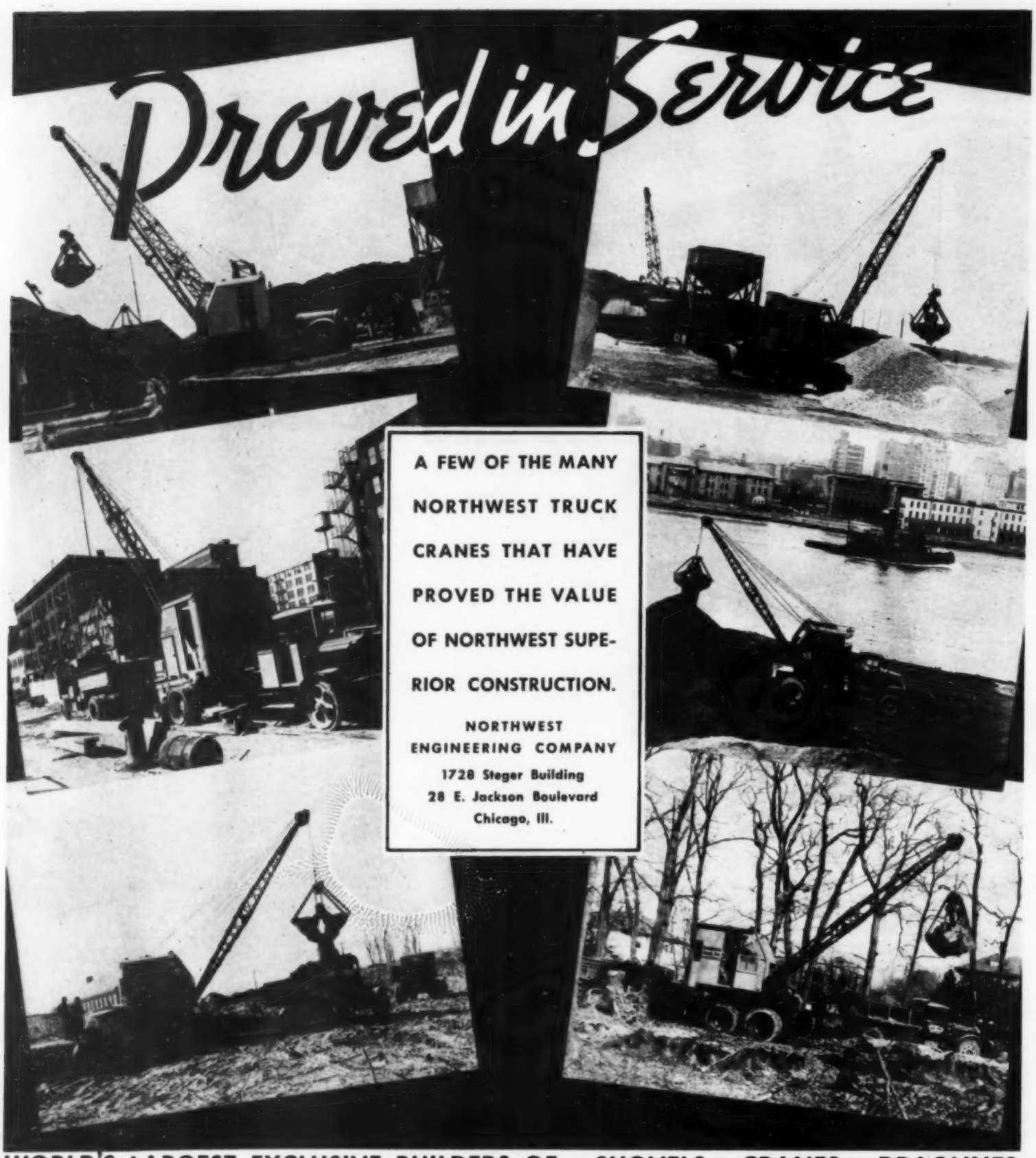
No Diesel can be any better than its FUEL SYSTEM
Read the record

CUMMINS Dependable DIESEL

PIONEER IN MODERN DIESEL DEVELOPMENT

Ask for your copy of The Dependable Diesel—72 pages of Cummins Diesel demonstration. Cummins Engine Co., 1220 Wilson St., Columbus, Ind.

Proved in Service



A FEW OF THE MANY NORTHWEST TRUCK CRANES THAT HAVE PROVED THE VALUE OF NORTHWEST SUPERIOR CONSTRUCTION.

NORTHWEST ENGINEERING COMPANY
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NORTHWEST TRUCK CRANE

Barber-Greenes for Higher Quality at Lower Costs

The Barber-Greene Travel Plant gives accurate proportioning and thorough mixing at road mix costs. Where conditions or specifications call for Central Plant operation, the Mixer Unit is detached and set up as shown below. Wheel mounted portability and set-up simplicity make it practical to set up at the best location for each job. The B-G continuous mixing principle gives remarkably high capacity per pound of machine. In addition to the flexibility of Travel or Central Plant operation, the B-G Loader can be used alone for innumerable profitable jobs: Loading from stock piles, stripping, pit excavation, light grading, backfilling, etc.

It will pay you to investigate these Barber-Greenes that give More Quality at Less Cost.

If you have not received your copy of "Good Roads" the new 52 page booklet that shows Barber-Greenes complete line for contractor's equipment, write today. There is no obligation.

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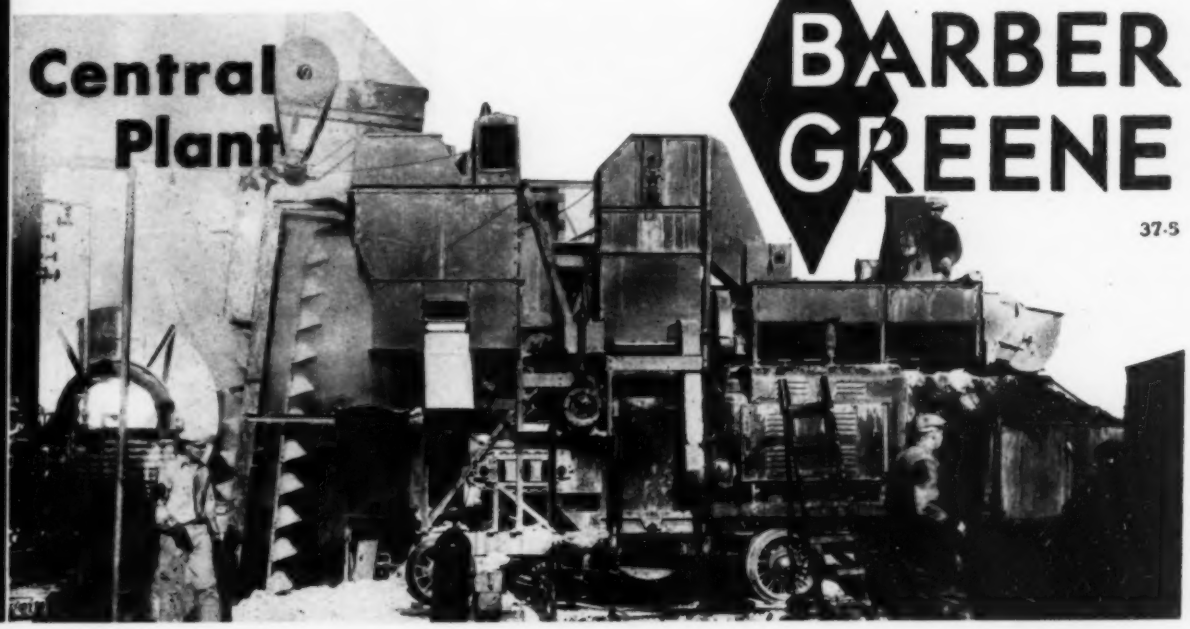
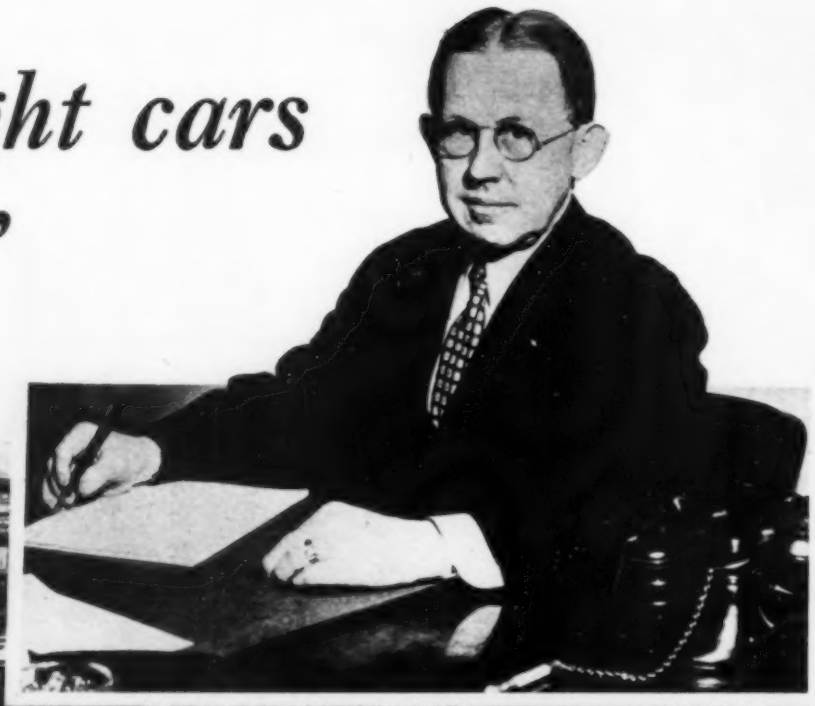
Aurora, Illinois

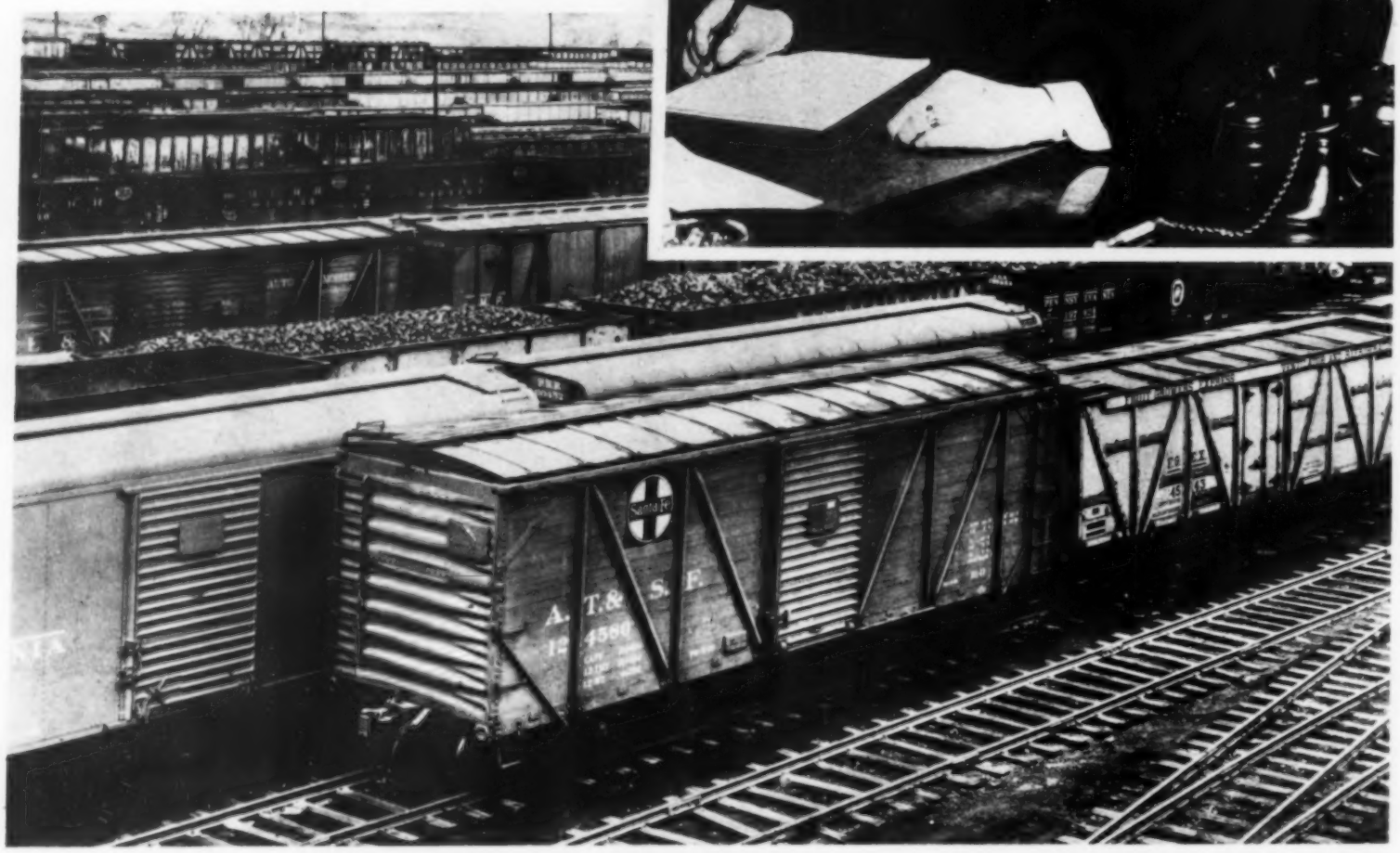
BARBER GREENE

37-S



"He pulls freight cars out of hats"





THIS is Traffic Manager Frank Guy. For more than thirty years this former railroad man has been helping our customers solve their transportation problems.

Somebody once said of him: "He knows his job so well he all but pulls freight cars out of hats." In a tight traffic situation, he has an uncanny knack of scaring up cars. In rush order jams, he seems to have a genius for getting the one available car on the one particular train that can insure delivery on time. Of course he's human—and therefore fallible—so he may slip; but not often.

He has at his fingertips the facts you want to know about rates, regulations, railroad practices. From this fund of practical information he often is able to save customers considerable time or money.

Frank Guy's job, like the jobs of other Universal Atlas men, is to insure for customers the best service possible. We think that giving this kind of service helps us sell more cement.

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Universal Atlas
CEMENTS

Construction Methods and Equipment

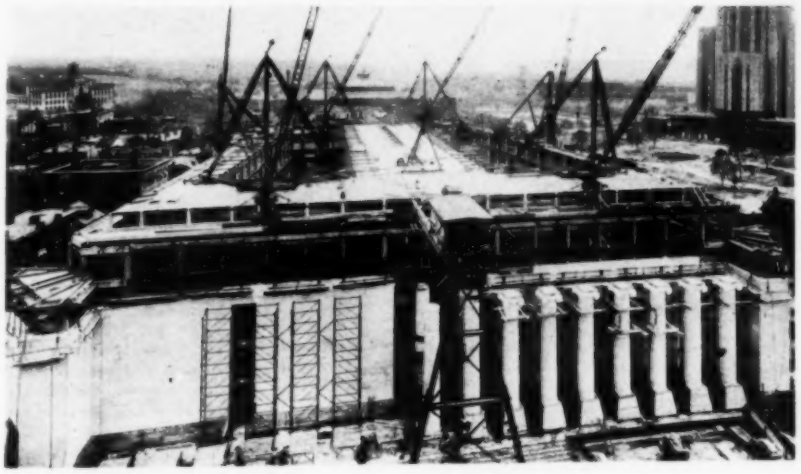
Established 1919 McGraw-Hill Publishing Company, Inc.

ROBERT K. TOMLIN, Editor

Volume 19 **June, 1937** Number 6

Science Temple Dedicated

MAY 5, 1937 . . . Completed structure, carried out in simple Greek architecture, ready for dedication.



OCT. 1, 1932 . . . Columns in place and roof nearing completion.

INTERNATIONALLY - KNOWN scientists assembled at Pittsburgh, Pa., May 5-9 to take part in the dedication of the new research building of the Mellon Institute, a broad, massive structure of classic beauty involving 4,329 tons of structural steel, 932 tons of reinforcing steel, 169 carloads of limestone, 45 carloads of marble and 4,000 tons of terra cotta. The building behind rows of 62 monolithic limestone columns, each 36½ ft. high and weighing 60 tons occupies about 6,500,000 cu.ft. and is wide in proportion to its height. The plan is trapezoidal, 306 ft. wide at the front, 227 ft. wide at the rear and 334 ft. deep. The structure is 80 ft. high and contains eight stories, three of which are below street level.

To produce the monolithic columns 125-ton limestone blocks were quarried and turned in huge lathes to produce each finished 60-ton shaft 36½ ft. long, with an average diameter of 5 ft. 9 in. Each column is supported by a concrete pier 45 ft. high with "mushroom", top 6 ft. in diameter. In Pittsburgh special 100-ton trucking equipment transported the heavy columns from the railroad yards to the building, crews of men traveling in front of the trucks to reinforce streets with steel plates at certain locations. Setting of the columns was done with special hoisting equipment.

The new research building for the Mellon Institute, for which ground was broken Nov. 5, 1930, is the gift of the late Richard B. Mellon and his brother, Andrew W. Mellon. The general contractor for the structure was the Mellon-Stuart Co., of Pittsburgh.

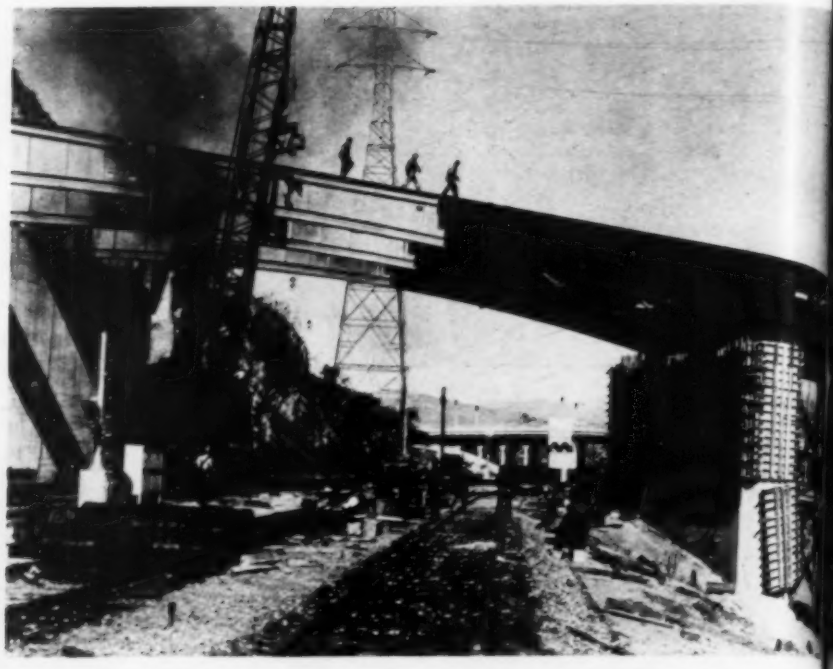
JUNE 6, 1931 . . . Excavation completed and foundations under construction.

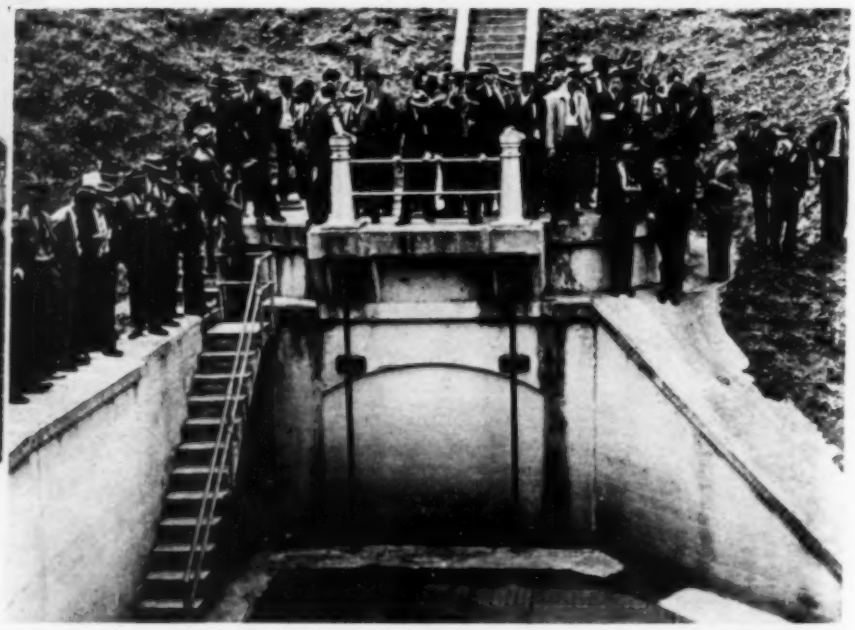
This Month's

"NEWS REEL"

NECHES RIVER BRIDGE

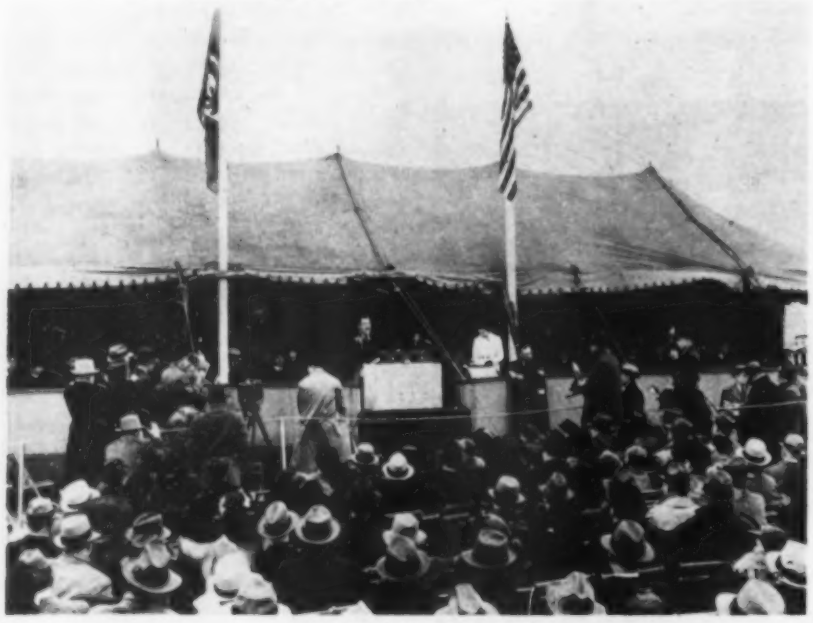
at Port Arthur, Tex., being built by Texas Highway Department with aid of local bond issue and PWA grant, rises as Taylor-Fichter Steel Construction Co., New York City, pushes erection of south approach spans under $1,613,000 superstructure contract. Bridge, costing $2,750,000, will provide 176-ft. vertical clearance under 680-ft. river span, where through trusses will reach total height 230 ft. above water, making structure tallest highway bridge in South. V-shaped towers supporting truss spans are designed to resist force of Gulf hurricanes. Derrick with 90-ft. boom has erected 1,220 ft. of south approach and has 1,900 ft. farther to go before reaching main river span. Bridge is scheduled for completion in March, 1938.





WATERWORKS TUNNEL COMPLETED

Headworks of new $1,000,000 Edisto River bore, 18½ mi. long, for waterworks of Charleston, S. C., is scene, April 28, of official dedication of completed aqueduct line. Through marl formation the 7-ft. bore of modified horseshoe section was excavated from 17 shafts spaced about 6,000 ft. apart, using drills and pneumatic spades. Project was completed under direction of J. E. Gibson, manager and engineer of the Charleston Water Department.

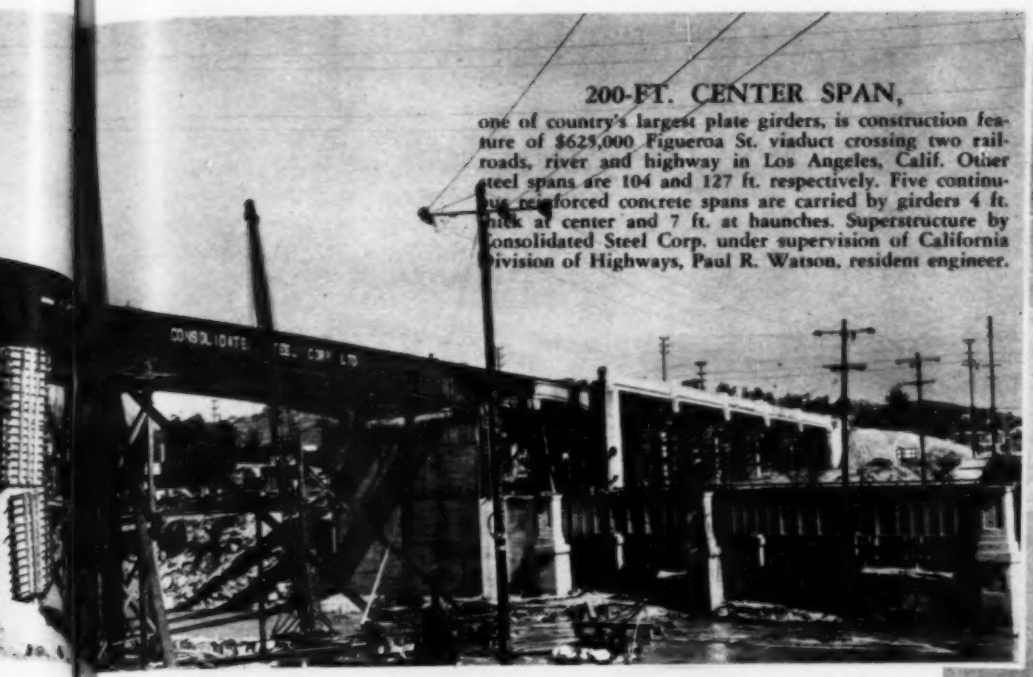


CORNERSTONE

for $900,000 Administration Building, first structure to be erected for New York World's Fair of 1939, is laid April 27 at Flushing Meadow site, with Grover Whalen, president of Fair Corporation, delivering dedication address.

KENFIELD HOUSING PROJECT

takes form *(right)* at Buffalo, N. Y. Under $3,999,400 contract with Housing Division of PWA, Fleischer Engineering & Construction Co., of St. Paul, Minn., (Alan H. Knight, superintendent) builds on 65-acre site group of structures to house 658 families.

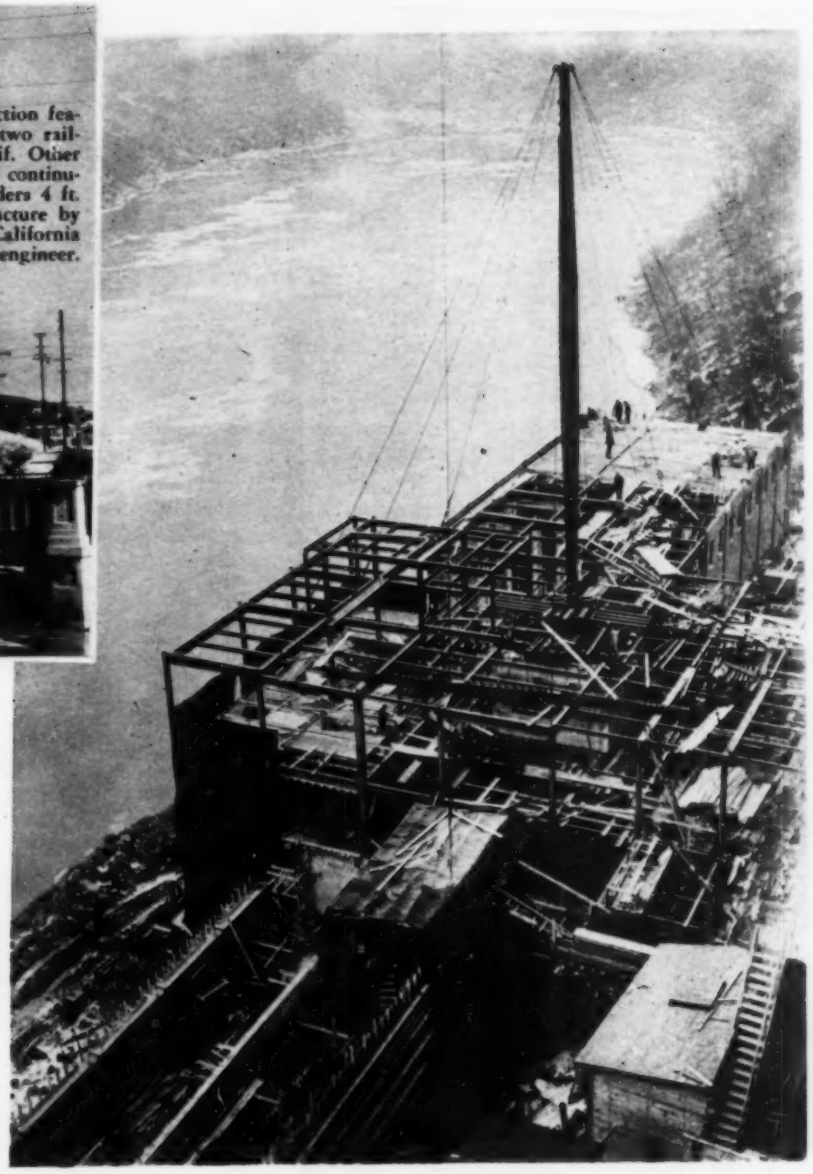


200-FT. CENTER SPAN,

one of country's largest plate girders, is construction feature of $625,000 Figueroa St. viaduct crossing two railroads, river and highway in Los Angeles, Calif. Other steel spans are 104 and 127 ft. respectively. Five continuous reinforced concrete spans are carried by girders 4 ft. thick at center and 7 ft. at haunches. Superstructure by Consolidated Steel Corp. under supervision of California Division of Highways, Paul R. Watson, resident engineer.

FIRST PAPER

in competition for $200,000 awards of the James F. Lincoln Arc Welding Foundation is received, May 12, by Secretary A. F. Davis, of Cleveland. Paper by R. S. Hale, Cincinnati architect, relates to electric welding in field of construction.



CLIFFSIDE SITE

is scene of construction of new $2,300,000 sewage disposal plant at Niagara Falls, N. Y., along picturesque Grand Gorge. Contractor, Francis A. Canuso & Son, of Philadelphia (James G. Davison, superintendent). Tall guy derrick handles material from top of cliff 574 ft. above river.

WATERING IDAHO DESERT

(above) Main canal of Payette division of U. S. Bureau of Reclamation's Boise project is reinforced concrete flume along toe of foothills of Payette Valley. As invert is concreted trainload of reinforcing steel arrives on job.

LAST RIVET

of solid gold *(right)* is held for driving into steel superstructure of San Francisco's Golden Gate bridge, April 28, by Chief Engineer Joseph B. Strauss. Ed Stanley operates gun while Ed Murphy serves as bucker-up.

The Problem of Labor Relations

—And a Suggested Plan for its Solution in the Construction Industry

By ARTHUR A. JOHNSON

President, The Arthur A. Johnson Corp., Engineers and Contractors, Long Island City, N. Y.

LABOR RELATIONS — there are no two words in the English language that have more significance in the construction industry than these two. Unfortunately there is not a subject that is more completely ignored by leading employers, more avidly exploited to the limit by sometimes irresponsible and incompetent labor leaders, and more frequently used as a political football by vote-seeking politicians. Under these conditions is it any wonder that labor and the employer are as far apart as the poles? In presenting my views on this important subject I am going to try to do so without bias or prejudice, stating facts and calling my shots as I see them:

Wage Rate Confusion

First, let us consider the New York State Labor Law. This law provides that the wages to be paid for a legal day's work shall be not less than the prevailing rate of wages in the locality and that it shall be the duty of the Industrial Commissioner, or the Fiscal Officer, to ascertain and determine the schedule of wages to be paid on each contract prior to the time of advertising for bids. Such schedule of wages shall be annexed to and form a part of the contract for the work. The contractor then receives the form of contract which stipulates the wages to be paid. Apparently the contractor now has official information with which to estimate his costs on the labor rates contained in and forming a part of the contract, as determined by the Industrial Commissioner or Fiscal Officer. If the contractor estimates on this basis

"Workmen who labor for a living wage are exploited more by their labor organizations than by their employers."

and is awarded the contract, let us see what happens:

When he starts to hire men at the rates of wages stipulated in his contract he is immediately bombarded by labor unions claiming that he is paying less than what they maintain is the prevailing rate of wages. The contractor naturally replies that he is paying the rates of wages stipulated in his contract, but the labor organizations point out that those rates of wages stipulated in the contract are the minimum rates which shall be paid, and while the contractor cannot pay less than these rates, there is nothing in the law to protect him from having to pay more. Since the rates of the labor organizations are higher than the rates stipulated in the contract, the contractor finds he has to pay rates higher than those called for in his contract and provide the difference out of his own pocket, if he expects to be furnished with employees to carry out his contract. Under these conditions how is it possible to have fair competition in the construction industry when the contractor suddenly finds that the rates he actually has to pay are those which have been decreed by a labor organization, without regard to the rates stipulated in the contract? How is it possible to have equitable and stable conditions and industrial peace?

The contractor has two alternatives: First, he can meet the demands of the labor organizations. Second, he can permit a strike to be called on his contract — disastrously expensive to himself, his employees and the public — and finally pay the union demand.

Naturally, the first question that presents itself is this: For what reason is a law placed on the statute books as misleading and ambiguous as this one? Secondly, if it is the duty and intention that state and city officials shall determine the rates of wages to be paid, and these rates become a part of the contract, then why, after the contract is entered into, are labor organizations permitted to usurp the function of the awarding authorities by demanding and enforcing other and higher rates?

Under the present Labor Law of New York State the Industrial Commissioner, or Fiscal Officer, must make a survey and determine the rates of wages prevailing for each particular contract. If that contract is not awarded within 90 days, he may be called upon to make another survey and fix other rates of wages. We have a condition, therefore, where the contract provisions are such that no similar rates of wages may be stipulated for any two contracts, and this in itself tends to bring about the chaos, confusion and industrial strife which are prevalent today.

The State Labor Law should be amended so as to provide that not more than once each year, on a fixed date, the city or state officer shall determine the rates of wages within predetermined zones on all construction work during the following year. These rates, when so determined, shall be binding on both the employer and employee for that period, with a further provision that on any contract let during such period the rates of wages then in force and being a part of the contract shall be maintained until the completion of that contract. A contractor then would know exactly how to estimate his labor costs, all contractors would be on the same basis and every workman would know exactly what his wages were to be within that period, resulting in industry stabilization.

As I see the picture, what is required more than anything else in all industry is a formula which will prevent industrial strife and resultant strikes. Up to the present time no procedure has been determined upon which has been successful in averting the inevitable break between employer and employee. There being no such procedure provided by law, negotiations are necessarily left to the haphazard, prejudiced actions of the parties involved, frequently resulting in long and costly strikes and, eventually, a settlement highly satisfactory to one party and unsatisfactory to the other. If such procedures or negotiations were provided by law there would be no necessity for a strike or stoppage of work, providing the decision was final and binding on both parties, which is absolutely necessary if we wish to have industrial peace, and which surely would accrue equally to the benefit of worker and employer.

As an employer of construction labor for a great number of years the thing that has struck me repeatedly is that the workmen who labor for a living wage are exploited more by their labor organizations than they are by their employers. I am, and always have been, a firm believer, under our existing system, in the right and urgent necessity that labor organize so that it can negotiate through collective bargaining as to rates of wages and conditions of employment, but I never could see why the workman should be called

"Under the Wagner Act labor organizations will be managed with a view to political expediency as the primary objective."

upon to pay the inconceivably high tribute he has to pay for this privilege.

Union Membership Costs

Let me recite a few instances of the initiation fees and dues demanded by labor organizations in New York City:

The initiation fee in one union, where the workman earns a salary of $70 a week, is $175, with monthly dues of $8.

The initiation fee where the workman earns from $45 to $50 a week, is $110, with monthly dues of $4.

In another union, a foreman earning from $50 to $60 a week, pays an initiation fee of $75.

In another union, where the work-

man earns $28 a week, the initiation fee is $32.50, with monthly dues of $2.

In another union, where the workman earns $35 a week, the initiation fee is $25, with monthly dues of $2.

These are only a few examples, but when the large numbers of workmen are considered they clearly show the vast amounts that the American workingman is called upon to pay out of his wages for the privilege of being represented in collective bargaining with his employer. Surely, this is a high price for such representation.

"The existing system has failed dismally to produce any kind of leadership that can successfully bring about amicable, satisfactory relations between employer and employee."

I firmly believe that the function of determining the rates of wages and conditions of employment is that of a State Labor Commission, *without cost to the employee*. If you stop to multiply the few figures I have given by the huge number of members in labor organizations in the State of New York, the first question that presents itself is: What becomes of these vast sums, and why should the men who work with their hands be called upon to provide them? If these rates of wages and conditions of employment were determined intelligently by a competent Labor Commission, then we would have stability and equity in our industry instead of the snowballing of rates and ridiculous rules of employment.

A Plan to End Strife

It seems to me that the matter could be worked out through state legislation in this way:

1. **The creation of a paid Labor Commission, which may consist of a lawyer, an employer and a labor representative.**
2. **This commission would divide the state into zones.**
3. **This commission would determine the proper rates of wages for a given period of time, the hours of labor, the terms and conditions of employment for each and every classification of employment within each zone, and these rates and conditions would become binding equally on the employer and the employee.**
4. **The creation of an impartial Board of Labor Review in each zone to hear and pass upon each and every violation or complaint, its decision to be final and binding equally on the employer and the employee. These Boards of Labor Review would also hold public hearings and determine all demands for increase or decrease of hours and wages, whether originating with the employer or the employee, and their findings should be binding on both employer and employee.**
5. **Provision for appeal from any decision of the Boards of Labor Review, possibly through the State Court of Appeals, which would be the court of last resort.**

This plan may be ahead of its time, but I firmly believe that something similar will be the future solution of the continuous conflict between labor and capital. One thing is certain: during the many years it has had the opportunity to do so, the existing system has failed dismally to produce any kind of leadership that can successfully bring about amicable and satisfactory relations between employer and employee. We have only to turn to our daily newspapers and read of strike after strike, the outrageous flouting of law and order, the vagaries and fantasies of strike leaders, to satisfy anyone that this is so. Is it not obvious that we turn our attention to other methods and other systems?

Effects of Wagner Act

Let us consider the effect of the Wagner Labor Relations Act. It is inevitable that the Wagner Act will bring in its wake the regulation of labor organizations. In all probability this law will mean that the control of labor organizations will pass out of the hands of the present type of leaders and will pass into the hands of a type that will be primarily political-minded. Those of the present labor leaders who are quasi-political will undoubtedly merge with the political forces in the country which will gain the control of these organizations. These organizations, therefore, will be managed with a view to political expediency as the primary objective, rather than the single objective of the advancement of the welfare of the workmen.

The intrusion of the new political factor will doubtless be initiated under the guise of protecting the public, but after this new group is in control, the management and regulation of the labor organizations will go the way of all other agencies that have heretofore come under political control.

On second thought, is the plan I suggest so far ahead of its time as it at first appears? The United States Government has already legislated the minimum price that can be charged for one commodity. The recently passed Guffey Act fixed the minimum price to be charged for coal, and doubtless, as is our general custom, this will soon be followed by other legislative acts fixing minimum prices for other commodities. Surely, if it is necessary to fix by law a selling price for a commodity, then it must be equally necessary to regulate by law the cost of the labor entering into the production of that commodity. Unless this is done, how is it possible to fix the minimum selling price, when labor is at least 55 per cent of the cost of production?

Merits of Plan

The plan I have proposed may have many flaws and objections. It is offered merely as a suggestion for serious thought and consideration, with a view to remedying the errors and weaknesses of the discredited existing system, but it certainly will do one thing: It will put millions of dollars into the pockets of the American workmen — millions of dollars which they are at present called upon to contribute without equitable return. If you do a little arithmetic, starting with the fact that there are probably 4,000,000 members of various labor organizations in the United States, multiply that by the initiation fees which these millions have paid to become members of their organizations and add to it the monthly dues exacted from each member, you will find the total staggering figure.

If the plan I have proposed does nothing else it will certainly remove all necessity for strikes, thereby saving many millions of dollars in the form of lost wages to the American workmen and many more millions to the long-suffering American public. Under this plan the employer would at least know the exact rates of wages he will be called upon to pay and the rules and conditions he will have to observe, without being subject to the sudden and exorbitant demands of labor organizations. The workman would know the exact wages he would receive, without being subject to the extortionate demands for a goodly portion of his annual wages in the form of union fees, dues and strike losses.

Moreover, it is my opinion, if we establish equitable and stable conditions, we shall go a long way toward insuring more continuous employment, particularly in the construction industry. We can criticize or approve financiers and financial institutions all we please, but the fact remains we must have capital to create employment, and we can hardly expect capital to spread itself before us when we do not know what the conditions in our industry will be six months hence.

The plan I have suggested would most certainly do another thing: It would abolish forever the vicious and costly jurisdictional disputes among competitive and opposing labor organizations, although they are all affiliated with and a part of the same federation of labor. The tragedy of these wasteful disputes is that the workmen, the employer and the public have to absorb the entire cost, notwithstanding that they are innocent victims of a dispute with which they had nothing to do.

Of course, there is an alternative to the plan I have taken the liberty to suggest. If the labor organizations are prepared to assume full responsibility for their actions, and by that I mean that they place themselves in the position that they can sue or be sued and have damages levied for or against them, then I believe there will be little, if any, necessity for any change in the present labor organizations set-up.

"The function of determining rates of wages and conditions of employment is that of a State Labor Commission, WITHOUT COST TO THE EMPLOYEE."

A. F. of L. vs. C. I. O.

It seems to me, however, that a change in the present system of labor organization in the United States is inevitable and is a matter of such grave importance that it merits the earnest consideration of every citizen. Right at the present moment we have the American Federation of Labor's domination of labor in New York City and State seriously challenged by various local unions created and organized by the Committee for Industrial Organization. If you take into consideration the success which has attended the organization efforts of the C.I.O. in other parts of the United States, it is useless to laugh this off as being of no consequence. If the C.I.O. is successful in obtaining a foothold in the organization of labor in New York City and State, then I can foresee very serious trouble ahead of us. We might then have two contending organizations, each seeking to dominate the representation of labor. The victims who will bear most of the cost will be the workmen, who will be forced to forego their wages while striking to gratify the ambitions of the contending groups, and that innocent bystander, the American public. And supposing the jurisdiction of these two groups is finally arrived at and agreed upon, the workmen will still be exploited into paying the same, or higher tribute for the privilege of remaining a member of either one or both of the organizations.

I stated at the beginning of this article that to think of labor relations suggests one word — chaos. I do not believe there can be any other conclusion as matters at present exist in the United States, but I do believe it is the duty of every thoughtful person, having in mind the splendid accomplishments and traditions of the American working man, to give serious consideration to this confusing problem, with a determination that each of us may continue our jobs in a peaceful, pleasant and profitable manner.

THE AUTHOR

ARTHUR A. JOHNSON, who discusses labor relations in the accompanying article, is head of the well-known New York contracting organization that bears his name and an employer of labor for a great many years. He is a past-president of the General Contractors' Association of New York. In association with the Necaro Co., Inc., he recently started work on a $4,715,863 section of the new Sixth Ave. subway in New York City, and has recently completed a 7,000,000-cu.yd. earth-moving and grading contract in preparing the Flushing Meadow site, on Long Island, for the New York World's Fair of 1939. Another of his recent contracts was for the Quabbin dike, a water supply project in Massachusetts, involving the placement of earth by unusual hydraulic methods.

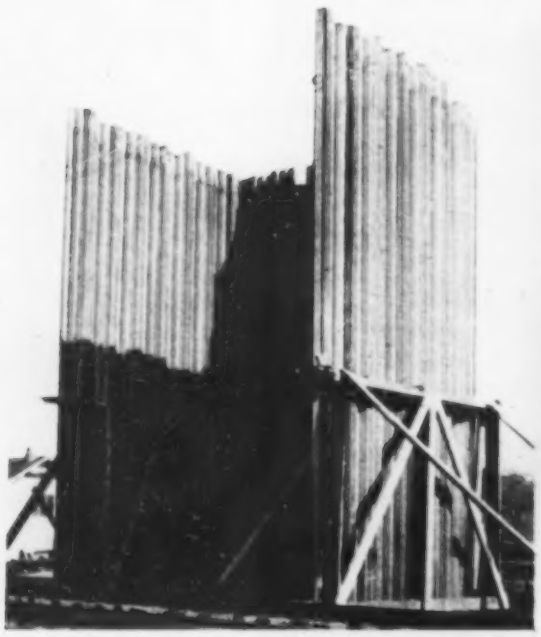
OVERHEAD WIRING of electrified railroad requires careful operation on part of crane operator.

Contractor Builds Underpass Beneath

Electrified Railroad Tracks

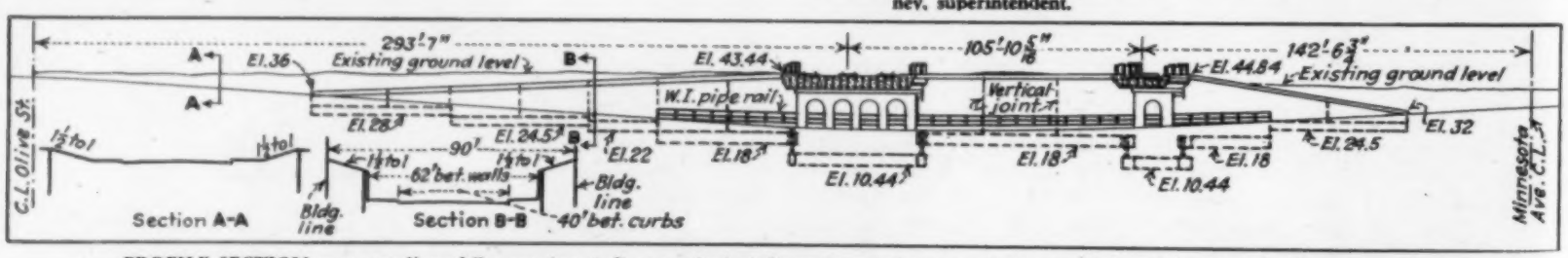
TO ELIMINATE a highway grade crossing involving two electrified railroad freight tracks and one steam track, the Diamond Construction Co., of Washington, D. C., last year completed the first Works Program grade separation in the District of Columbia, using various types of falsework and sheeting to support tracks and earth trenches while excavating and constructing concrete footings and abutment walls. An excess of clay in the soil at the site obviated need of well points, and small centrifugal pumps lifting water out of sumps proved capable of removing all inflowing seepage from the excavation.

A siding track paralleling the two electrified freight tracks of the Pennsylvania Railroad at the site simplified the handling of double-track traffic during construction, as required by specifications. The siding track was inside the double line of steel poles which carried both the high-tension overhead system and the catenary wires of the trolley system. It was possible without serious difficulty to switch one traffic track and trolley wire over to the siding track, leaving the other two



TIMBER GUIDE *(left)* supports steel sheetpiling set up for driving alongside two electrified railroad tracks.

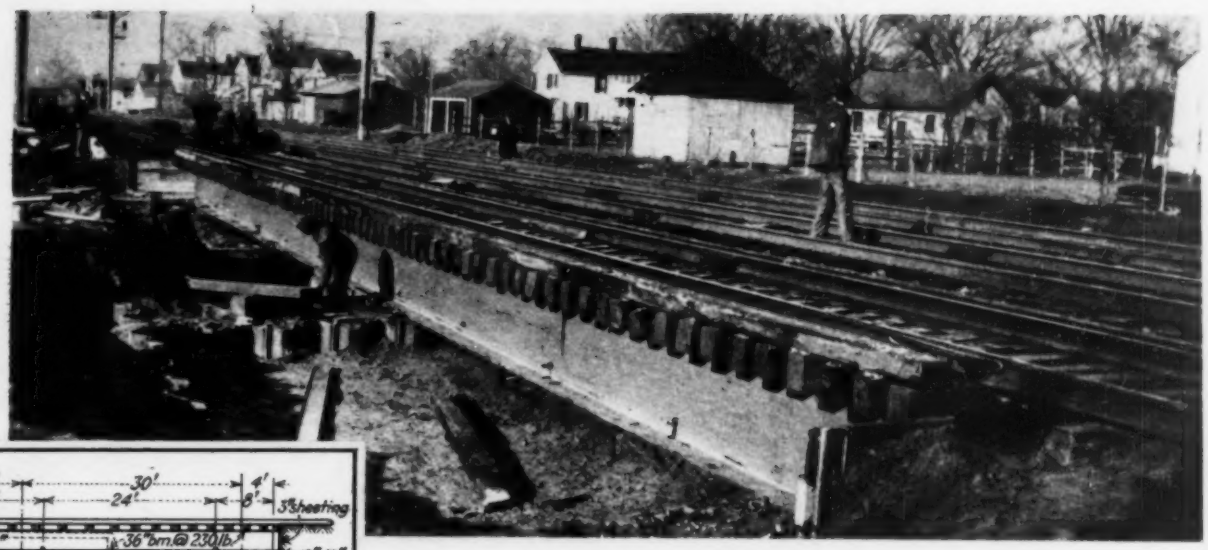
IN CHARGE of operations at Eastern Ave. underpass are (left to right): N. G. Tayman, resident engineer for District of Columbia; A. E. Dubber, Jr., engineer for Diamond Construction Co.; B. F. Diamond, contractor; and M. A. Spinney, superintendent.

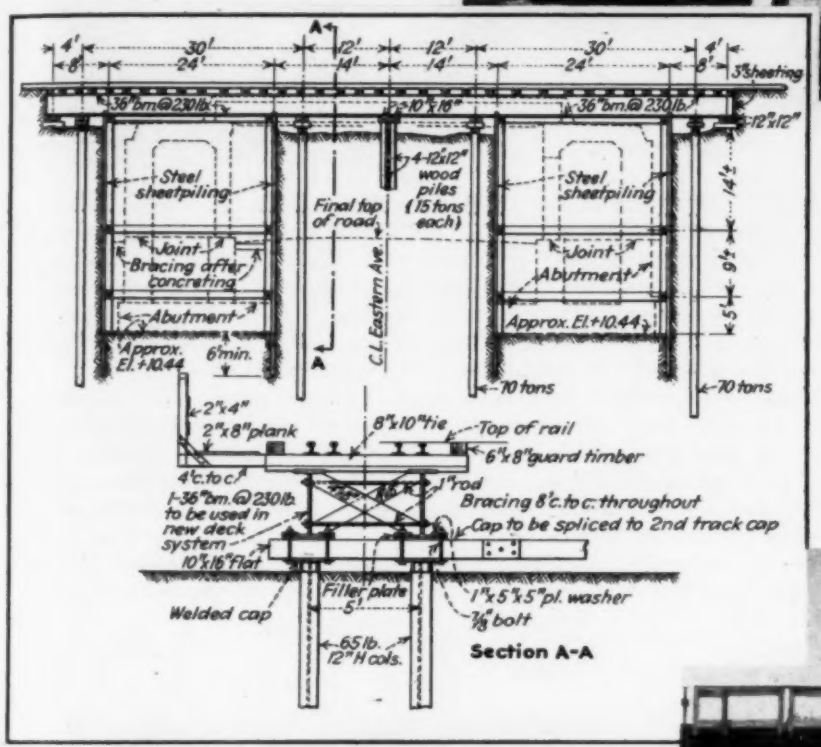


PROFILE SECTION on center line of Eastern Ave. indicates principal dimensions and structural characteristics of first Works Program grade separation completed in the District of Columbia. Two of three tracks on bridge at left are equipped with overhead wiring for electric railroad operation.

Major Construction Quantities
Eastern Ave. Underpass
Washington, D. C.

Item	*Approx. Quantity*
Grading	13,875 cu.yd.
Excavation	9,400 cu.yd.
Concrete	3,345 cu.yd.
Struct. steel	279,300 lb.
Reinf. steel	237,580 lb.
Waterproofing of bridge decks	470 sq.yd.
Waterproofing of other surfaces	3,000 sq.yd.
Drain, 24-in. T.C. pipe	1,200 lin.ft.



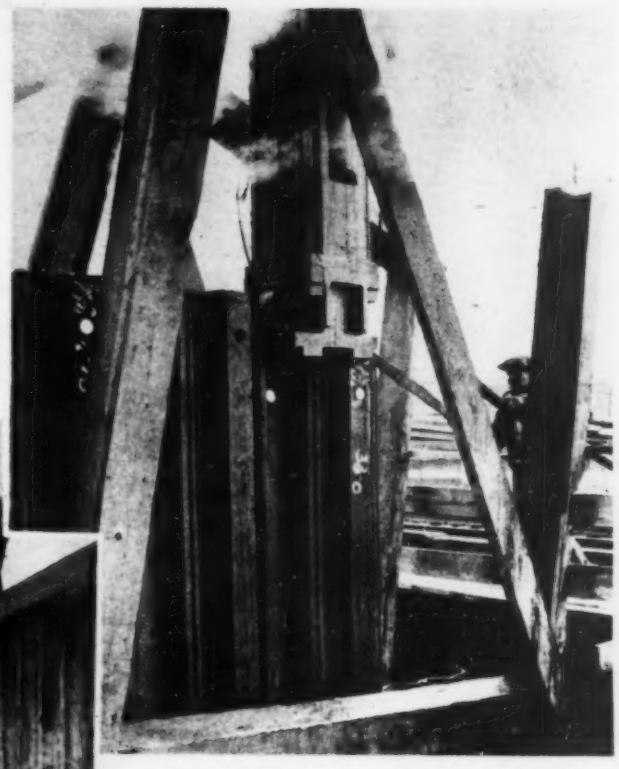


Section A-A

TEMPORARY TRACK SUPPORTS for excavation of P.R.R. bridge carrying two electrified tracks and one siding track include steel H-piles with a capacity of 70 tons each and cluster of four timber piles with capacity of 15 tons each under each rail. Lines of steel sheetpiling appropriately shored and braced support earth banks and earth core into which steel and timber piles are driven. For each track at this location contractor installs total of eight steel H-piles 46 ft. long and eight 12x12-in. hardwood timber piles which are driven to practical refusal at depth of about 14 ft.

STEEL BEAMS supported by temporary piles and timber sills carry railroad track during construction of underpass. Lines of steel sheetpiling have been driven to permit excavation for bridge abutments.

DOUBLE HINGES and multiple sheaves *(below)* provide digging power in contractor's lightweight ¾-yd. clamshell bucket.

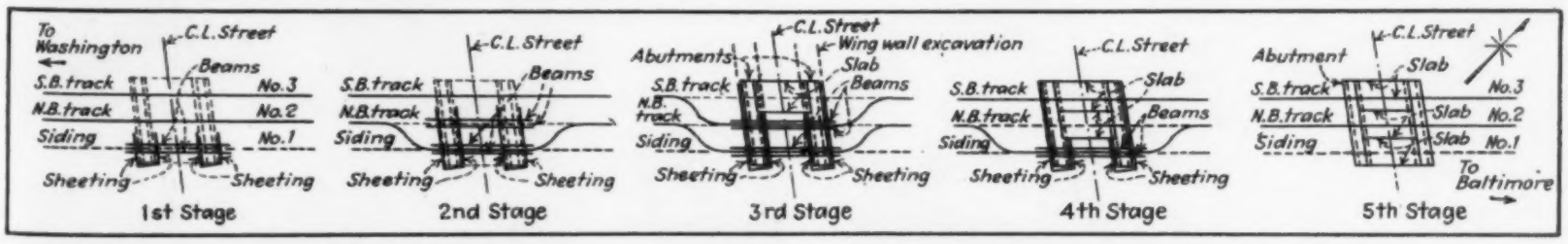


1,500-LB. SHOE protects head of steel sheetpile from impact of 1,600-lb. piston in 7,650-lb. double-acting steam hammer in hard driving.

track locations to be used alternately while this portion of the underpass was being built in sections. This procedure is illustrated by the five diagrams of the accompanying construction schedule. The contractor built and maintained the temporary traffic system for the P.R.R. Great care had to be exercised by crane operators and foremen to prevent contact with the electric system.

Temporary relocation of the single steam track of the B. & O. R. R. presented no difficulty. In this case the contractor built a trestle, and the railroad company placed the track and ballast and diverted traffic to the detour track. All operations were carried out under the direction of the engineer of bridges, in the office of the director of highways, for the engineer commissioner of the District of Columbia.

Features of Project — As indicated by the accompanying profile section on the center line of Eastern Ave., the underpass consists of two steel I-beam



FIVE STAGES of construction schedule for building highway underpass under two electrified railroad tracks and one siding track call for following procedure.

First stage: (1) Abandon and remove siding track over bridge location. (2) Place sheeting; excavate for and place temporary beams and sills. (3) Shift northbound track and wires to operate on line of siding track as shown in second stage diagram.

Second stage: (1) Place sheeting; excavate for and place temporary beams and sills on original line of northbound track. (2) Shift southbound track and wires to operate on line of northbound track on temporary beams as shown in third stage diagram.

Third stage: (1) Place sheeting for remainder of abutment excavation. (2) Complete excavation for abutments by trenching under tracks, including north wing walls. (3) Complete construction of abutments for entire bridge. (4) Place beams, construct slab and waterproofing, and complete superstructure slab for southbound track, including wing walls. (5) Shift southbound track and wire to original position on completed slab. Ballast, line and surface track as shown in fourth stage diagram.

Fourth stage: (1) Remove temporary track supports, place beams, construct slab and waterproofing and complete superstructure slab for northbound track. (2) Shift northbound track and wires to original position on completed slab. Ballast, line and surface track as shown in fifth stage diagram.

Fifth Stage: (1) Remove temporary track supports, place beams, construct slab and waterproofing, and complete superstructure slab for siding track. Excavate for and construct wing walls. (2) Reconstruct siding track in original position on completed slab. Ballast, line and surface track. (Track raised). (3) Complete excavation below slab for roadway.

Contract includes permanent pumping unit but does not include paving of roadway and sidewalks.

and concrete slab bridges, one carrying the three P.R.R. tracks and the other the single B. & O. track. A roadway 40 ft. wide between curbs is flanked on both sides by sidewalks which pass through colonnades under the bridges. An accompanying table indicates approximate quantities of major construction items involved in the project. The value of the work performed under the contract of the Diamond Construction Co., which does not include paving of the roadway or sidewalks, was about $135,000. Completion in 300 calendar days was specified. Contract time started Feb. 17 and ended Dec. 1, 1936.

TWO CRAWLER CRANES handling ¾-yd. clamshell buckets on 50-ft. booms remove bulk of excavation from subway cut.

PORTABLE CENTRIFUGAL PUMP with 3-in. discharge removes inflowing water from sump.

Sheeting — To retain the sides of trenches during excavation and concreting of the abutments, the contractor used 8,160 lin.ft. of arch-web steel sheetpiling in 35-ft., and a few 25-ft., lengths. The sheetpiles were 15 in. wide and 5 in. deep, giving the arch a total depth of 10 in.; the sheets weighed 37 lb. per linear foot.

Sheetpiling was driven with a 7,650-lb. double-acting steam hammer with a 1,600-lb. piston. The hammer was hung from a crane boom, no leads being used. In hard driving, the steel sheetpile was capped with a driving shoe weighing 1,500 lb.

For supplemental sheeting of shallower lifts and for holding earth banks where loads and vibrations were less severe, the contractor used wood sheeting driven with hand mauls.

Falsework — As indicated by the accompanying drawing of falsework under one of the electrified freight tracks, each track was carried by a pair of steel beams supported on driven H-piles and clusters of wood piles. These piles were installed before the contractor began the driving of the steel sheetpile walls for the abutment excavation.

In the case of the single steam track, the contractor first installed steel sheetpiling and trestle bents on the location of the detour track. The steel sheetpiling was driven in parallel lines to permit excavation for the retaining walls. After the contractor had completed the trestle, the railroad company placed ballast and rails and diverted traffic to the detour track. The lines of sheetpiling then were extended to inclose the abutment areas at the two ends of the bridge. According to the plan worked out by the contractor and accepted by the railroad, the bridge and the retaining walls on both sides of it were completed before the railroad laid the track on the new structure and restored traffic to the permanent line.

Drainage — After experimenting with well points, the contractor discarded this system and depended upon two heavy-duty 3-in. centrifugal pumps, each having a capacity of 10,000 gal. per hour, to remove groundwater drainage from the excavation. These pumps demonstrated a remarkable self-priming ability; one of them held its prime on a 27-ft. suction lift.

Excavation — Two gasoline crawler cranes took care of the setting and driving of piles and of the excavation. To set and drive piling, one of the cranes was equipped with a 60-ft. boom. For excavating purposes, both of the units were fitted with 50-ft. booms. Actual digging was done with two multi-sheaved heavy-duty clamshell buckets of ¾-yd. capacity. These buckets possessed a double-hinged multiple-sheave feature which gave them good digging ability with light weight. As the contractor ordinarily operates the buckets on 60-ft. booms, he needs light buckets with superior digging power.

Concrete — For exposed concrete surfaces on the faces of the retaining walls and abutments, the contractor used 1¼-in. t.&g. lumber in sectional panels. On the backs of the walls, the forms were constructed of 1-in. dressed lumber in panels or relaid.

A 1-cu.yd. paving mixer was moved about the site as required to supply concrete at different points. Batch trucks hauling from a commercial plant delivered dry materials to the mixer. All concrete above footing grade was vibrated with a high-frequency flexible-shaft internal vibrator driven by a gasoline motor.

Administration—Col. Daniel I. Sultan, Corps of Engineers, U. S. Army, is engineer commissioner of the District of Columbia, H. C. Whitehurst is director of highways, and C. R. Whyte is engineer of bridges. At the site of the Eastern Ave. underpass, N. G. Tayman, resident engineer, was in charge of operations.

For the Diamond Construction Co., B. F. Diamond is president, M. A. Spinney, superintendent, and A. E. Dubber, Jr., engineer.

HAND MAULS *(right)* **drive wood sheeting to retain earth banks for lower lifts of excavation.**

STEAM HAMMER *(below)* **hung from crane boom drives 46-ft. steel sheetpiles to grade.**

Bridge Maintenance Service

Assured by Trucks with Special Equipment

MODERN MAINTENANCE SERVICE used on the new San Francisco-Oakland Bay Bridge is provided by a fleet of specially constructed General Motors trucks, including two tow trucks, a fire truck, tower truck, and paint truck. Since the opening of the bridge Nov. 12, 1936, more than 2,500,000 vehicles have crossed, with only 44 accidents. Up to March 1 of this year the maintenance crew serviced 2,249 vehicles, supplying 1,249 of these with gasoline, towing off 694 because of engine trouble or accidents. In addition, 250 tires were changed and nine fires extinguished by the fire truck.

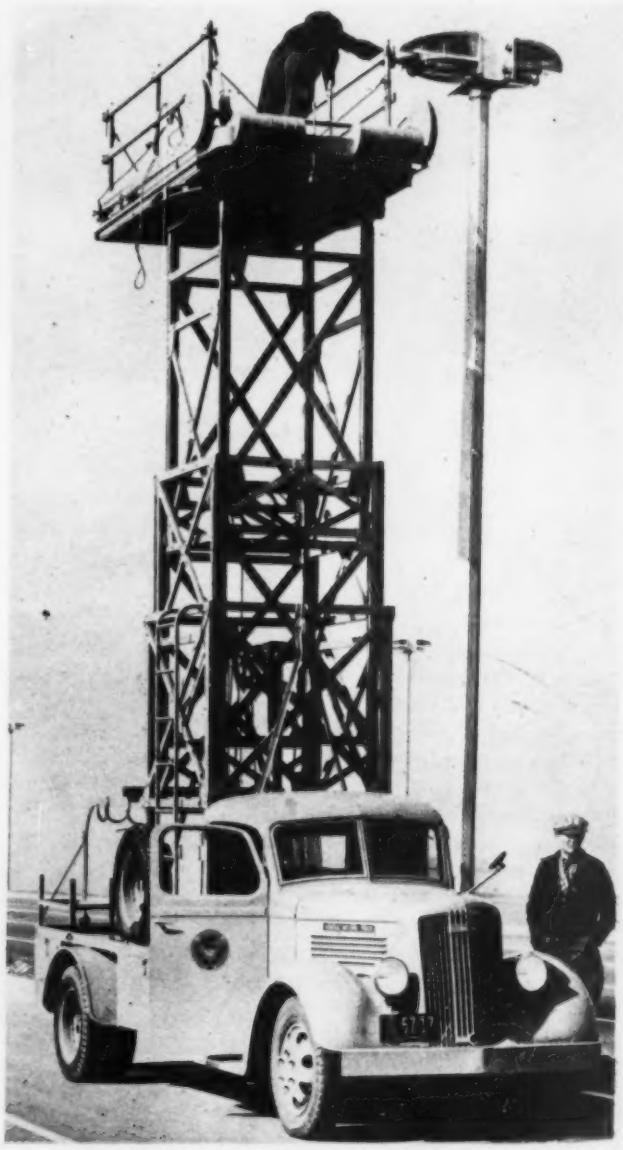
Outstanding among the features of the bridge maintenance service is the use of an auto-call system for summoning tow or fire trucks. Thirty-two red call boxes, similar to the common fire alarm box, are distributed at intervals along the upper and lower decks. The stalled motorist can send in an automatic call for either a tow truck or a fire truck by simply breaking a glass window on the box.

The trucks are equipped with dual tires at the rear, to give sure traction for speeding up the 3.6 per cent grade of the bridge approaches. The tow trucks carry heavy manila tow ropes and other equipment for pulling disabled automobiles. They also are equipped with cranes for lifting cars clear of the pavement, and with gasoline supplies for accommodation of motorists.

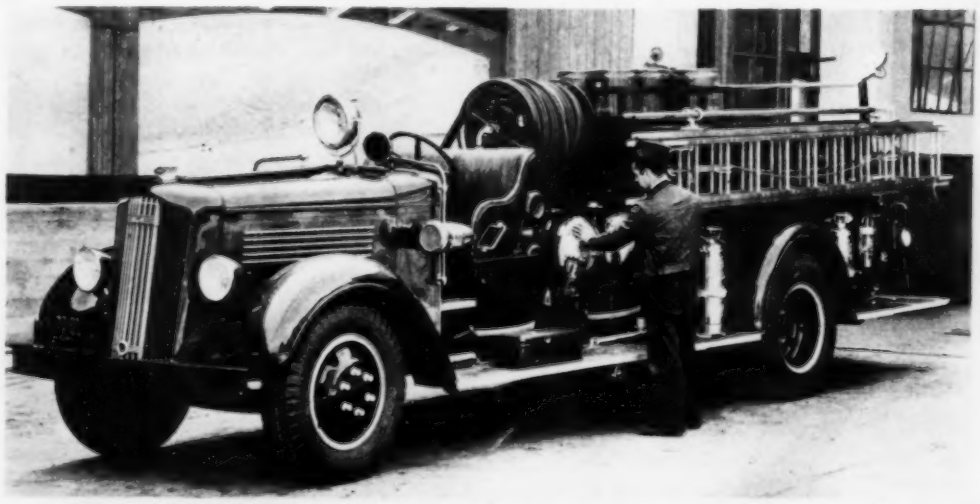
For proper maintenance of the 1,074 sodium vapor lamps which illuminate the bridge and approaches, the electrical department of the bridge uses a General Motors tower truck with a platform that will raise to 24 ft. above the roadway and will extend out 10 ft. to the side. By use of this platform, which turns around completely and can be extended out and around a lighting pole, service men can easily clean the lamps and make lamp replacements every six months. Raising and lowering of the platform is accomplished with a hydraulic hoist. Turning of the top platform is done by means of a hand crank.

Another truck is used by the bridge paint crew in its never-ending job of repainting the lengthy structure. This truck has compartments for hose, spray guns, paint brushes, paint, and has a compressor unit for supplying the power for paint spraying.

All this equipment is kept available 24 hr. of the day with operators on hand to serve as needed. On an average, 21 vehicles per day, or one out of every 1,120 cars crossing the bridge, have utilized one or another of the services thus supplied.



LIGHTING MAINTENANCE is aided by truck carrying telescopic tower with revolving platform that can be elevated to height of 24 ft. by means of hydraulic hoist.

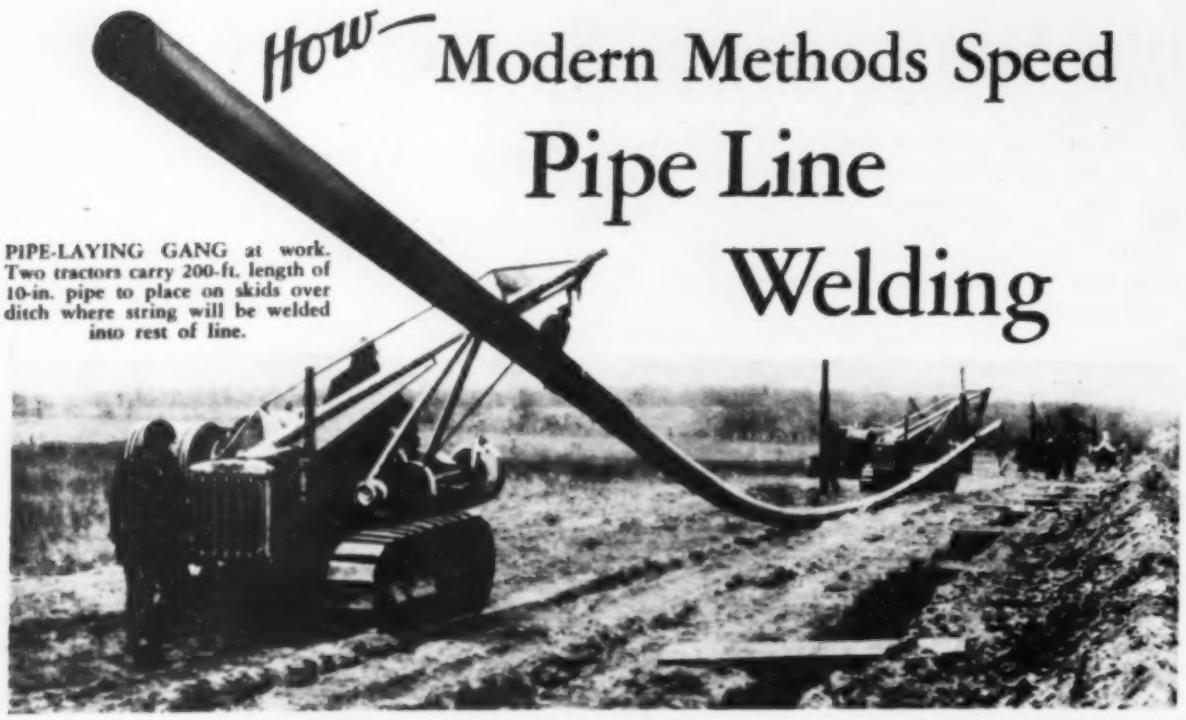


FIRE FIGHTING EQUIPMENT is carried by one of the trucks of the fleet. It is summoned by 32-box auto-call alarm system.

AUTO-CALL BOXES, distributed along bridge *(left)*, enable motorist to summon fire or tow truck quickly.

TOW TRUCK *(above)* carries crane on rear end to raise disabled cars.

How Modern Methods Speed Pipe Line Welding



PIPE-LAYING GANG at work. Two tractors carry 200-ft. length of 10-in. pipe to place on skids over ditch where string will be welded into rest of line.

By T. R. JONES
President, T. R. Jones, Inc., Dallas, Tex.

[Paper, slightly condensed, presented at annual convention of International Acetylene Association]

PIPE LINE WELDING is production welding, carried on by a field organization whose main objective is the maximum number of welds, or the maximum footage along the right-of-way, per working day. The pipe line organization has been built around the old ripple welding methods and has consisted of three primary elements: (1) Line-up gang. (2) Firing-line, or welding, gang. (3) Laying gang.

The function of the line-up gang is to align the pipe on skids and dollies and tack-weld the joints sufficiently to retain the alignment during the welding operations.

The firing-line gang is the production organization. The pipe is turned or rolled as the welds are made and a sufficient number of firing-line welders are employed to give the required daily footage along the right-of-way. When ripple welding was commonly practiced five or more years ago, this welding organization would consist of 8 to 12 or more welders and it was the practice to team these welders in groups of four on a single "roll" or section of pipe. At that time, of course, the linear speed of welding was considerably less than what we are obtaining today. It was entirely feasible, therefore, to gang these men together as a single group. Unfortunately, this was not conducive to high welding speeds, for if there were one or two men on the "roll" who were slower than the others, the rate of welding was set by them.

The laying gang follows the firing-line gang. The function of this organization is to bend the pipe to fit the terrain and align succeeding sections in position to be tack-welded. Then bell-hole or tie-in welds are made by a small welding organization consisting of 2 or 3 men.

This is essentially the organization that is used today under the term of roll welding or "storm-gang" operation. Many advances have been made in oxy-acetylene welding during the last five years, having to do principally with the speed of welding, or an increased output per welder per day. Some adjustment has correspondingly been made in the pipe-line organization, but essentially the same three elements of the line-up, firing-line, and laying gangs have been retained.

There are certain defects in this organization from the standpoint of efficient operation. The output per welder has been increased 300 to 400 per cent, with the result that the firing-line organization now consists of only 4 welders. Even with only 4 welders on this gang, a considerable burden has been placed upon the line-up organization to provide pipe in sufficient quantity to keep ahead of the firing-line gang. The size of the line-up gang has been increased, and more mechanical equipment is employed in an endeavor to keep up with the pace set by the firing line. The consequence has been that it costs nearly as much to line and tack the pipe as it does to weld the pipe.

Increase in welding speed has had further complications. It is no longer possible to team a considerable number of men on a single "roll." The present-day demand for high quality of welding dictates the use of a single welder to a section. Each welder has his own helper who turns the pipe to suit the welder's requirements. Because of the high linear welding speed, the pipe must be carefully and accurately aligned prior to tacking. An even spacing around the circumference of the joint is essential in order that the penetration of the weld metal will be maintained down to the very root of the

FIRING-LINE GANG makes welds as pipe is rotated on dollies, or saddles, by chain pipe tongs.

Photos, The Linde Air Products Co.

LINE-UP GANG handles pipe with derrick boom mounted on side of tractor.

TYPICAL FIRING-LINE scene, showing welder making joint above dolly on which 200-ft. string is rotated by helper with chain pipe tongs so that point of welding is always at top of pipe.

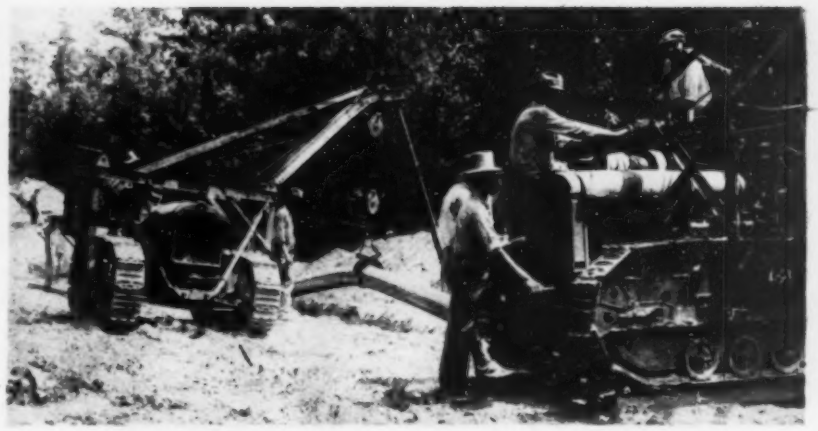
weld. In hot weather this accuracy in alignment is complicated by the effect of the sun on the pipe. Sun temperatures in the mid-continent area will get as high as 130 to 140 deg. F., this heat on one side of the pipe causing a differential expansion to take place which results in the pipe bowing slightly, or becoming what, in pipe line phraseology, is called "rainbowed." This effect is minimized by having the pipe ahead of the line-up gang frequently turned so that there will be less differential temperature from one side of the pipe to the other.

It is not uncommon for the firing-line gang to progress 18,000 to 22,000 ft. along the right-of-way per 9-hr. day. In rough country this is greater speed than the laying gang can keep up with. For example, on the recent 178-mi., 6-in. gasoline line for the White Eagle Oil Corp., the complete 178 mi. was "fired out," leaving the laying gang approximately 100 mi. behind.

These factors seem to indicate that there is an element of unbalance with our present organization technique. Some 12 or more years ago a few short lines were ripple-welded, using an entirely different organization set-up. These welds were all bell-hole welds. In other words, the conventional line-up and firing-line organizations were dispensed with completely and all of the operations were consolidated with the laying gang. This method was not feasible at that time because ripple bell-hole welds were extremely slow to make, with the result that the daily footage was cut down to a mere 1,500 to 1,800 ft. Bell-hole welds can now be made by the newer methods, however, almost as rapidly as rolling welds. In fact, there is but a 10- to 20-per cent penalty in the way of increased welding time required to make our present-day tie-in welds. Consequently, the all-bell-hole welding method has been gaining a considerable amount of attention.

All Bell-Hole Method — I have used this procedure with my own organization in the laying of a good many relatively short lines in Texas, and recently applied it to the laying of 50 mi. of 10-in. pipe in Kansas for the Texas Empire Pipe Line Co. This represented fairly large-scale operations, and a careful analysis was made from the standpoint of efficient organization and low cost of operations. This method of pipe lining, which is called "stove piping," involves considerable departure from the older practices. The bending gang is moved up to the front end and consolidated with the line-up and tacking gang; the firing-line and bell-hole gangs have been consolidated into a single welding organization. The pipe is bent either in single or multiple-joint sections and aligned in position on skids over the open ditch. When properly aligned, the joint is tacked and the front end gang moves on to the next joint.

Some distance behind the front end is the welding organization. This distance may be anywhere from a few hundred feet to ⅓ mi., depending upon right-of-way conditions and the number of bends which have to be made to fit the pipe to the ground contour. No particular difficulty is experienced with "rainbows" in the pipe and the use of dollies is dispensed with completely because the pipe is not rolled as it is being welded. All of the operations are consolidated within a relatively narrow area, with the consequence that better supervision can be maintained from one end to the other. The daily footage is reduced somewhat over the older storm-gang methods, but the overall progress of completed line, ready to be lowered into the ditch, is equivalent to that obtained by the usual laying-gang organization.



BENDING OF PIPE to fit contour of trench bottom is done with tractors rigged with boom attachments.

BELL-HOLE WELD illustrated by "worm's-eye" view.

PIPE CLAMP insures accurate joint alignment when tying in 200-ft. string to end of line. Operator is making first of three or four tack-welds, after which clamp is removed for making bell-hole weld.

TACK-WELDING joint between string and open end of line. Tractor in background has carried string into position over ditch.

ALL-BELL-HOLE METHOD of pipe-line construction, with tractor in background, lining up 40-ft. lengths of pipe on skids over ditch. Joints are clamped prior to tack-welding, shown in foreground. Note pipe wrapping to prevent corrosion.

With technical improvements in the welding process which have increased bell-hole welding speed, it would appear that improvements are necessary in the purely mechanical operations in order to keep pace with present-day welding ability. There are two factors that tend to reduce progress with the stove-pipe method: These are (1) the speed with which the pipe can be bent; and (2) the footage of ditch which can be opened per day. Anything that can be done to speed up these operations will enable the contractor to weld increased footage at lower costs. Ditching machines are kept running 24 hr. a day at the present time and frequently the welding is held up because of lack of sufficient ditch.

Joint Design and Pipe Material — There appears to be a definite trend today relative to joint design for welding and the type of pipe material used for overland lines. Oxy-acetylene welding has always favored the open butt-joint design from the standpoint of simplicity, low costs and high overall joint efficiency. Bell-and-spigot pipe was used on a few lines some years ago, but was discarded in favor of the double bell and inner liner. Double-bell pipe has still been retained in a few instances, either because of the desire on the part of operating engineers to use arc welding—which has required the inner liner or chill ring for backing up purposes—or because of the viewpoint of some oil company engineers who felt that this design increased the overall joint efficiency. I believe the welding fraternity is pretty well agreed, as a result of exhaustive tests, that maximum joint efficiency is obtained from the single V butt weld.

It is a rather curious thing to me that less consideration is given to the open butt-joint design for the welding of big inch lines, particularly for gas transmission. I believe it has become substantially a standard practice to require the use of chill-ring liners with plain end pipe in sizes 16 in. and larger. Certainly the practices in the mid-continent area in the laying of oil, gas and gasoline lines during the last 5 years have adequately demonstrated

COMPLETE LINE-UP AND WELDING CREW on 10-in. oil line constructed by all-bell-hole or "stove pipe" method of welding. Crew at left is lining up 40-ft. pipe lengths over ditch, after which joints are tack-welded and then all-bell-hole welded by Lindeweld method. Every umbrella shades a welding operator. Each truck carries acetylene generator and oxygen cylinders for supplying two welders.

the consistent strength of the open butt joint, as exemplified by probably 6,000 mi. of line which have been laid by the Lindeweld process, the new, fast method of oxy-acetylene welding employed by our organization.

Possibly some confusion exists as to the necessity for chill-ring liners in these big inch gas lines. Whether the welding process is electric or gas, there is a joint design best suited to each process. It so happens that arc-welding costs can be considerably decreased through the use of a backing-up strip or chill-ring liner. The insistence upon this liner for use in conjunction with oxy-acetylene welding, however, amounts to the same thing as putting a penalty on gas welding. This is not the joint design which is most acceptable and most economical for gas welding. Assuming the one process to be substantially equivalent to the other, when properly applied, it is difficult

ROLL WELD being made by welding operator using multi-flame Lindewelding head.

for me to appreciate the line of reasoning which demands a chill-ring liner for big inch gas lines, regardless of which welding process is to be employed.

Pipe Materials — The last few years have witnessed some interesting developments in pipe materials and pipe fabrication. Practically all new pipe is today specified as Class B. This material has a nominal tensile strength of 60,000 lb. per square inch minimum—actually the tensile strength will be closer to 72,000 lb. per square inch. Lap-welded pipe has practically disappeared and in its place is either seamless or electric-welded pipe. Apparently much better attention is being given by the mills to their fabricating methods, since pipe ends are more accurately sized than formerly and but very little trouble is now experienced with egg-shaped ends.

The higher strength material has led to the substitution of lighter wall pipe for equivalent operating conditions. Part of this trend toward lighter wall thickness is due to these improved physical characteristics and part to a more scientific attitude toward soil corrosion. Coating materials have been considerably improved upon and some of the oil companies have even gone so far in this matter of combating corrosion as to make soil surveys along the right-of-way to determine scientifically to what extent wrapping or coating shall be used. This is a logical step as considerable money can be saved, not only in the gross tonnage of steel required for a given line, but also in the freight charges on this tonnage. In all likelihood some consideration will be given in the near future to the use of Class C material, having still higher physical properties, as we develop the technique for combating corrosion. If and when this material, having an actual ultimate strength in the neighborhood of 85,000 to 90,000 lb. per square inch, becomes a reality, we may have our own problems in welding material of this high tensile strength so that the welded joint will be as strong as, or stronger than, the metal being joined.

Solid Welded vs. Composite Construction — It sometimes seems to me that the pipe-line contractor, through his close-range association with all of the engineering aspects of pipe-line construction, maintains a better perspective regarding some of the aspects of this work than do the engineering organizations which draw up the specifications. There has always been a difference of opinion among contractors on one hand, and the oil or gas industry on the other, as to how far we should go in the employment of solid welded construction. Practically everyone concerned is in agreement that pipe sizes up to and including 12 in. can be laid solid welded without any concern for contraction stresses. But when we get into so-called big inch pipe, the argument is that we must use composite construction.

I cannot see the argument. The whole technique of laying a pipe line is directed toward putting the line in compression before and as it is backfilled. Of course, most of the problem is in putting the compression where you want it, but this is simply a matter of laying technique. It is just as easy to put slack in a 16- or 24-in. line, as in a 6- or 8-in. line if the ditch is dug wide enough and deep enough. But it is an extremely hard matter to sell that idea to the pipe-line companies.

Some field experiments have been going on for the last two years in the laying of big inch lines which may have considerable influence on this question of "whether to weld or whether to couple." I am referring to the experiments conducted with Naylor spiral welded pipe. This pipe, as you know, has an upstanding ridge where the spiral weld is made and there is a certain amount of flexibility to withstand expansion or contraction due to this method of fabrication. Several short lines up to several miles long have been laid of 24-in. pipe, which has been solidly welded together and laid into the ditch without any attempt whatsoever to put compression on the line. This sort of pipe develops an excellent ground friction due to the upstanding seams and practically no movement of the pipe can take place after the ditch has been back-filled. It is my understanding that these tests have been carried practically to the point where all concerned are convinced of the feasibility of laying lines of any length by this method.

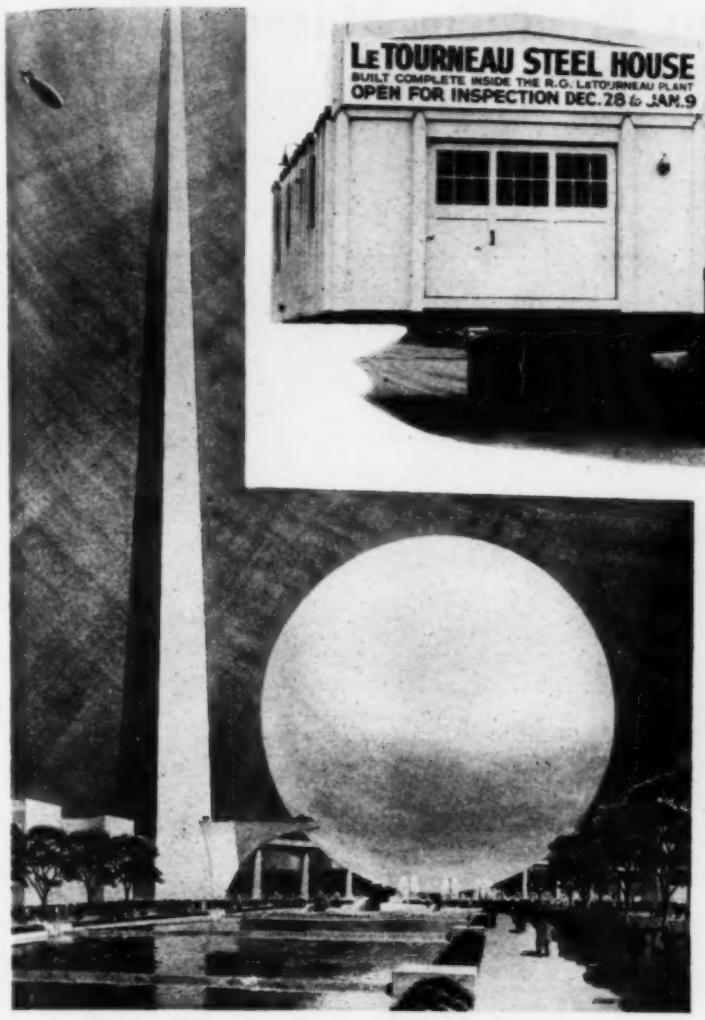
Operating stresses on overland lines are fairly high. In a good many cases pressures in oil lines are carried up to 700 or 800 lb. per square inch. I presume that the usual process piping specification for these high pressures would require extra heavy pipe and it may surprise some of you to know that pipe having a wall thickness of only ¼ in. and a diameter of 12 in., is being used for these high-pressure operating conditions. There is, of course, no particular hazard to human life should failure of either the weld or the pipe material occur, but you can readily appreciate that main-line failure would be an extremely expensive proposition for the pipe-line company.

Welders' Qualification Tests — Certainly, if any failure should take place, we do not want it in our welds. Therefore, welders are given an extremely stringent qualification test prior to their working on the line. The principal aim of welding inspectors during the process of construction is to maintain the same high quality of workmanship demonstrated by the qualification tests. Welders who successfully qualify have to make a weld in the same pipe material which will be employed on the line. After this weld is made, whether it is a rolling weld or a bell-hole weld, four coupons for tensile test are cut. The first coupon is taken at the completion, or seal-off of the weld, and the other three are spaced equidistant around the circumference of the joint. A portable tensile testing machine is used and each coupon is pulled to failure.

In order to qualify, at least three of the four coupons must break in the pipe material. On some jobs all four are required to break in the pipe but

TRENCHING MACHINE on crawler mounting opens up ditch in which welded pipe is laid.

this is a little too severe. In this procedure, no attention whatsoever is paid to the actual tensile strength developed during the test. The sole requirement is that the coupon must fail in the pipe. Since Class B pipe, with a specified strength of 60,000 lb. may have an actual strength of 72,000 to 75,000 lb., it is conceivable that coupons might fail in the weld at a strength substantially higher than that of the specified strength of the material. But this is entirely beside the point; failure in the weld disqualifies the coupon.



41-TON LOAD

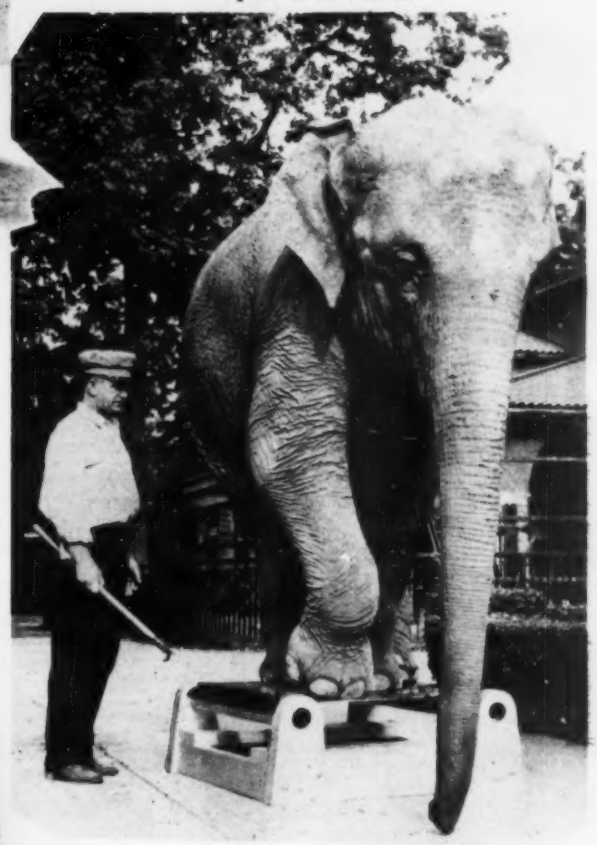
in form of all-steel, shop-fabricated house is mounted on semi-trailer and hauled to site in Peoria, Ill., by Chevrolet truck.

KEY BUILDINGS

(left) for New York World's Fair of 1939 comprise 200-ft.-diameter Theme Perisphere, with its piers screened by clusters of fountains to create illusion of huge ball poised on jets of water, and a 700-ft. triangular obelisk, or Trylon, a unique architectural form, serving as a Fair beacon and broadcasting tower.

TOUGH TEST

Pane of ½-in. thick Tuf-Flex tempered glass, *(below)* 36 in. square, new Libbey-Owens-Ford product, supported at two ends 1 ft. above ground, carries weight of 3-ton elephant standing upon it. Special treatment consists of heating ordinary plate glass until almost plastic, then cooling outer surfaces suddenly by jets of air so that exterior faces are in compression while inner portion of pane is in tension

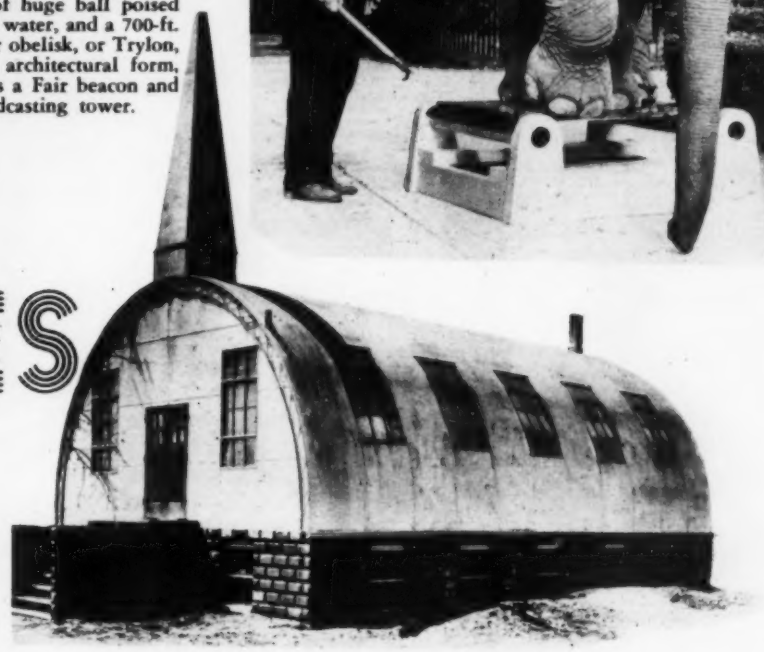


JOB ODDITIES

A MONTHLY PAGE OF

Unusual Features of Construction

"You know her too, eh Boss?"



ALL-WELDED CHURCH

Steel structure built by R. G. Le Tourneau at Peoria, Ill., is fabricated, by electric-arc welding, from half-circles of 3/16-in. steel plate, supported by curved trusses. — *Photo from James F. Lincoln Arc-Welding Foundation.*

BOONDOGGLING TECHNIQUE

utilizing maximum of hand labor is applied to road construction by natives in great rubber producing area at Pahang, Malaya.

Complete Batching and Mixing Plant Produces Material for

Stabilized Soil-Stone Base Course

PAVING MIXER set up on bank above roadway delivers mixed batches of clay, crushed limestone and stone dust to 5-yd. trucks which distribute material as required for construction of stabilized base course. Smaller batch trucks deliver properly proportioned 4,000-lb. batches to skip of paving [illegible]

CONSTRUCTION OPERATIONS are directed by Morris Hart *(left)*, of Hart & Hart, associated on this contract with Robinson, Gregory & Co.

SET UP in stationary position adjacent to a clay borrow pit alongside the road to be improved, a 27-E paving mixer produced mixed batches of crushed limestone, stone dust and clay for the 6-in. stabilized base course 20½ ft. wide of a highway construction project 2.8 mi. long on state route 60, at Borden, Ind., completed last fall by Robinson, Gregory & Co. and Hart & Hart, contractors, for the Indiana Highway Commission. The 6-in. base was built up in three equal layers, each of which was sprinkled, rolled and allowed to dry before the succeeding layer was placed. Following completion of the stabilized base course, the contractors constructed a 2-in. bituminous retread (road-mix) wearing course. These notes describe only the base construction.

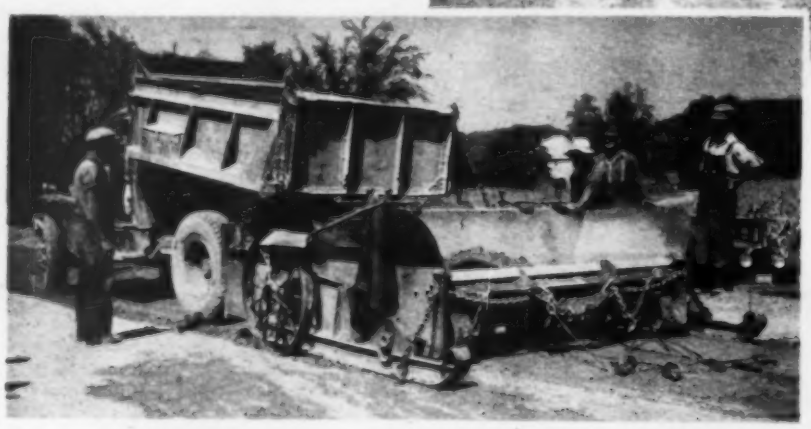
Ingredients of the designed base mixture were measured by weight at a complete batching plant set up in conjunction with the mixer, and 4,000-lb. batches were weighed out in about the proportions shown in the accompanying table. Water to the amount of about 18 gal. per batch was added at the mixer to facilitate handling of the material without segregation. Because of the large proportion of limestone and the small percentage of silt-clay, it was possible to add this moisture in the drum-type mixer without causing any difficulty. With a larger proportion of fines, an equal amount of water could have been added only in a pug-mill mixer.

Weighed ingredients of the base mixture were transported to the mixer by batch trucks, which dumped their loads into the mixer skip. The mixer itself was set up on a bank to permit dumping of mixed batches from the boom bucket into trucks on the roadway. At the point where the material was to be placed, these trucks hooked on to a spreader box which distributed the mixture in the proper depth to produce a 2-in. compacted layer.

Contract Quantities — As will be noted from the accompanying table of contract quantities and prices, a large amount of borrow excavation for the construction of highway fill, together with a large number of drainage structures, increased the total value of the contract to $115,500. For 2.806 mi. of 6-in. base (shown 20 ft. wide on the plans but actually constructed 20½ ft. wide to provide edge support for the widening effect of future maintenance) the contract called for 11,600 tons of soil-stone mixture.

Two 95-hp. diesel tractors pulling 12-cu.yd. scrapers mounted on pneumatic tires moved about two-thirds of

SPREADER BOX equipped with floating runners distributes uniform layer of material across half of base width at a time.



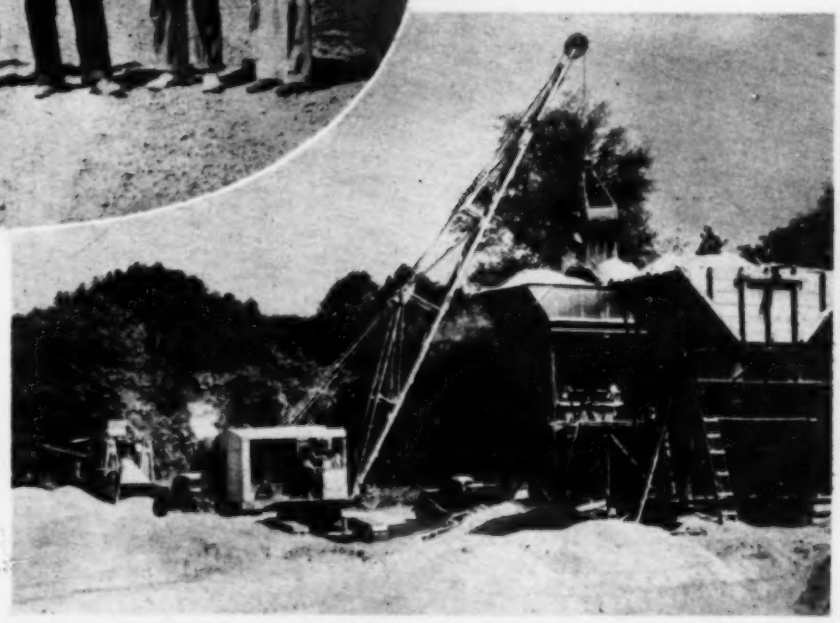
READY TO BE MOVED to another location on project, rear end of spreader box *(left)* is attached to truck body. Runners float on axles of two front wheels, which are here exposed to view.

INDIANA HIGHWAY DEPARTMENT is well represented by (left to right) F. A. Thornbury, project engineer; Elmer Riddle, inspector; W. P. Leake, assistant district engineer in charge of construction; J. A. Kiovsky, assistant project engineer; Ben Gentry, inspector; and U. W. Pfeffer, district clerk, Seymour, Ind.

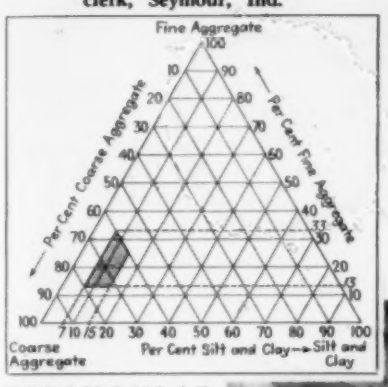
Typical Batch Proportions

Material	*Weight*	*Per Cent of Total*
Crushed limestone	3,145 lb.	78.7
Limestone dust	695 lb.	17.3
Clay and silt	160 lb.	4.0
	4,000 lb.	100.0

Percentages of ingredients given in this table cannot be applied directly in triangular chart because items listed in table do not correspond with ingredients indicated on chart.



TWO SETS of overhead bins equipped with weighing hoppers are set up near paving mixer to measure out three ingredients of stabilized base mixture.



TRIANGULAR CHART for calculating stabilized soil-stone base mixture on this project has darkened area to indicate permissible percentages of three ingredients entering into mixture. Percentages of various ingredients are read in directions at 60-deg. angles to three sides of equilateral triangle. Arrows indicate these directions. Thus allowable proportion of silt and clay ranges from 7 to 15 per cent.

DIVIDER *(left)* with alternating chutes splits material samples for testing laboratory set up on project by division of tests, Indiana Highway Department.

the total volume of 115,000 cu.yd. of excavation required on the project. One of these units later was transferred to the clay pit. The remaining excavation was moved by a dragline excavator operating a 1¼-yd. bucket on a 40-ft. boom. This machine served later in shaping shoulders.

Mixture Design — Permissible proportions of the three ingredients of the base mixture are indicated by the shaded area on the accompanying triangular chart. The contract was awarded under Indiana's 1935 specifications which called for a plasticity index between 3 and 9 for the soil fines passing a No. 40 sieve. This specification was revised in 1936 to permit a plasticity index from 0 to 9 for soil fines in stabilized mixtures.

For the job at Borden, the engineers desired to hold the plasticity index at 3, the lowest value permitted by the 1935 specifications. Of the clay excavated from the pit at the mixing plant, about 97 per cent passed a No. 40 sieve. Sufficient fine dust passing the No. 40 sieve was added to the mixture to reduce the plasticity index for soil fines to the desired value of 3. For a brief, simplified explanation of the term, plasticity index, which may be defined as a mechanical measure of the binding quality of clays or soil fines, the reader is referred to the article, "Indiana Builds Stabilized Salt-Soil Road," *Construction Methods*, January, 1936, pp. 60-63.

As the coarse aggregate for the base mixture, the contract specified No. 3 stone (Indiana specification), which might be classed as 1-in. commercial size. Of the crushed limestone in this size supplied by a commercial plant to the Borden project, 81 per cent was retained on a No. 10 screen, and 7.8 per cent passed a No. 40 sieve, while about 4 per cent passed a No. 270 sieve. The stone dust used in the base mixture contained about 15 per cent passing a No. 270 sieve.

Batching and Mixing Plant — Crushed limestone and stone dust were delivered by truck and were stockpiled within a short distance of the mixer. The contractor erected two batching units to take care of the three ingredients of the mixture, each unit consisting of an overhead bin and two weigh batchers under which batch trucks were loaded. One of the bins was used for clay and stone dust batches while the dual compartments and batchers of the second unit were utilized exclusively for stone. A gasoline crane equipped with a 50-ft. boom lifted materials from the stockpiles to the bins in a 1-yd. clamshell bucket.

A mixing period of 40 sec. was specified, but the contractor lengthened the period to 1 min. to facilitate handling of the mixture and to expedite discharging and dumping. Water added to the batch at the mixer was taken from an adjacent stream until this source dried up. The contractors then installed a 1,500-gal. storage tank to which water was hauled at intervals by the sprinkler trucks. A triplex pump was used as required to pump water from storage to the tank on the mixer.

Construction operations were carried on 12 hr. a day and 6 days a week. The average output of the mixer was 300 batches per 12-hr. day, although daily production occasionally amounted to almost 400 batches. A 4,000-lb. batch did not push the mixer to its full capacity, as the drum was capable of taking a batch of 4,200 lb.

Clay Pit — Operations in the clay pit were laid out to maintain good

MULTI-BLADE MAINTAINER smooths surface of 2-in. layer after material has been placed by spreader box.

THREE-WHEEL ROLLER weighing 10 tons compacts 2-in. layer after wetting. Water tank and pipe system on roller keeps all three wheels wet to prevent material from sticking.

TANK-TRUCK with capacity of about 1,000 gal. wets layer prior to rolling with 10-ton three-wheel roller.

drainage and prevent collection of pools of water. When the clay became wet, various means were employed to excavate and pulverize it for transfer to the stockpile at the batching set-up. Under ordinary conditions of moisture, the clay could be squeezed and pulverized by using the 12-yd. scraper with a narrow opening between the pan and the gate. For somewhat wetter conditions, it was customary to use a blade grader to throw up a windrow of the clay and then to flatten this windrow under the weight of the heavy scraper. When the clay reached its worst condition of saturation that still permitted working, the tractor operator first broke it up with a disk harrow before applying the other procedures.

Base Construction — When building subgrade by hand proved slow, the contractors quickly discarded this method and set steel road forms to permit operation of an R.B. power subgrader. The work was sometimes continued during the night with the aid of a 3,000-watt generating plant which supplied current to several 500- and 600-watt floodlights equipped with reflectors. Between these large lights, the contractors illuminated the work with a number of 100-watt lamps erected on saplings.

Contract Quantities and Prices

Item	Quantity	Unit	Unit Price	Amount
Common excavation	20,830	Cu. yd.	.35	7,290.50
Special borrow	93,094	Cu. yd.	.50	46,547.00
Sidewalk	20	Sq. yd.	1.80	36.00
Sidewalk removal	24	Sq. yd.	20	4.80
Sidewalk relaid	4	Sq. yd.	75	3.00
Crosswalk	59	Sq. yd.	2.00	118.00
Riprap	450	Sq. yd.	3.00	1,350.00
Flexible steel plate guard rail	684	Lin. ft.	1.00	684.00
Guide posts	55	Each	2.00	110.00
C. M. plate arch No. 5 gage, span 14 ft., rise 4 ft. 9 in.	55	Lin. ft.	20.57	1,131.35
Crushed stone or gravel surface, Class "C"	979	Tons	2.25	2,202.75
Aggregate for shoulder drains	77	Tons	3.25	250.25
C. M. pipe 54-in.	52	Lin. ft.	7.50	390.00
" " 84-in.	68	Lin. ft.	13.25	901.00
" " 66-in.	52	Lin. ft.	10.30	535.60
Sewer pipe V.C. 12-in.	50	Lin. ft.	1.10	55.00
C. M. pipe 12-in.	300	Lin. ft.	1.10	330.00
" " 15-in.	366	Lin. ft.	1.35	494.10
" " 24-in.	162	Lin. ft.	2.25	364.50
" " 30-in.	142	Lin. ft.	2.85	404.70
" " 36-in.	110	Lin. ft.	4.00	440.00
" " 42-in.	52	Lin. ft.	4.85	252.20
Drain tile for subsurface drains 6-in.	200	Lin. ft.	.45	90.00
V. C. sewer for subsurface drains 6-in.	200	Lin. ft.	.60	120.00
Agg. for subsurface drains	20	Tons	3.50	70.00
Finished mixture for stabilized material base	11,612	Tons	2.80	32,513.60
Bitum. matl., prime coat T.C.	10,485	Gal.	.119	1,247.72
Bit. matl. for bit. retread (L.A.)	45,279	Gal.	.10	4,527.90
Agg. for bit. retread, Class "A"	3,622	Tons	2.35	8,511.70
Conc. for structures, Class "D"	197.9	Cu. yd.	19.50	3,859.05
Conc. for structures, Special Class "D"	13.2	Cu. yd.	25.00	330.00
Reinf. steel for structures	7,141	Lb.	.05	357.05
			Total	$115,521.47

A fleet of nine 5-yd. trucks was available for hauling material. To distribute their loads of base mixture, these trucks hooked on to a spreader box adjusted to the proper width and equipped with floating runners. The trucks fed the mixture into the spreader box as they drew it forward, laying one-half the width of base at a time. To get a straight pull without any lifting effect at the front of the spreader box, Morris Hart, in charge of construction for the contractors, attached the hauling cables by shackles to the truck frame forward of the rear axle.

A tractor-drawn multi-blade maintainer smoothed the material in each layer after it had been applied by the spreader box. Following this operation, each 2-in. layer was sprinkled by two 1,000-gal. tank trucks and was rolled by a 10-ton three-wheel roller. In hot sunny weather, a layer would dry out sufficiently in 24 to 36 hr. to permit placing of the succeeding layer. When the days were cloudy, more than a week sometimes was required to dry out a layer.

Administration — Merton R. Keefe is chief engineer of the Indiana Highway Commission, and Sultan G. Cohen is construction engineer. The improvement on state route 60 at Borden was carried out under the general direction of Ray H. Bower, district engineer, Seymour. Operations on the project were directed for the State Highway Commission by F. A. Thornbury, project engineer, and for the contractors by Morris Hart. The contract was executed by the associated construction firms of Robinson, Gregory & Co., Owensboro, Ky., and Hart & Hart, Columbus, Ind.

Rolling Work Bench

for assembly of heavy expansion joint unit on New Jersey paving contract of P. Camillo & Co., Westfield, N. J., carries tools, materials and wood block supports *(left)* for setting premolded filler and channel dowels in position. After assembling joint complete with dowels, transverse supporting channels and angles, clips and cap, two joint setters *(right)* lift entire unit from platform to subgrade and screw channel supports to brackets attached to road forms or to edge of slab previously placed.

"Empire of the West"

Dramatizes Aqueduct Construction

INSIDE STEEL FOR
for open-cut aquedu
and carriage for mo
ing it.

CONSTRUCTION SHOTS. From top to bottom of film: (1) Diversion tunnel portals at Parker dam site; (2) Conduit construction in Coachella Valley; (3)Completed canal section; (4) Back-filling completed concrete conduit with walking dragline; (5) Gene pumping plant and delivery line from East portal of Copper Basin Tunnel No. 1.

EARLY CALIFORNIAN ROLE. in prologue, is played by Leo Carrillo (at left)

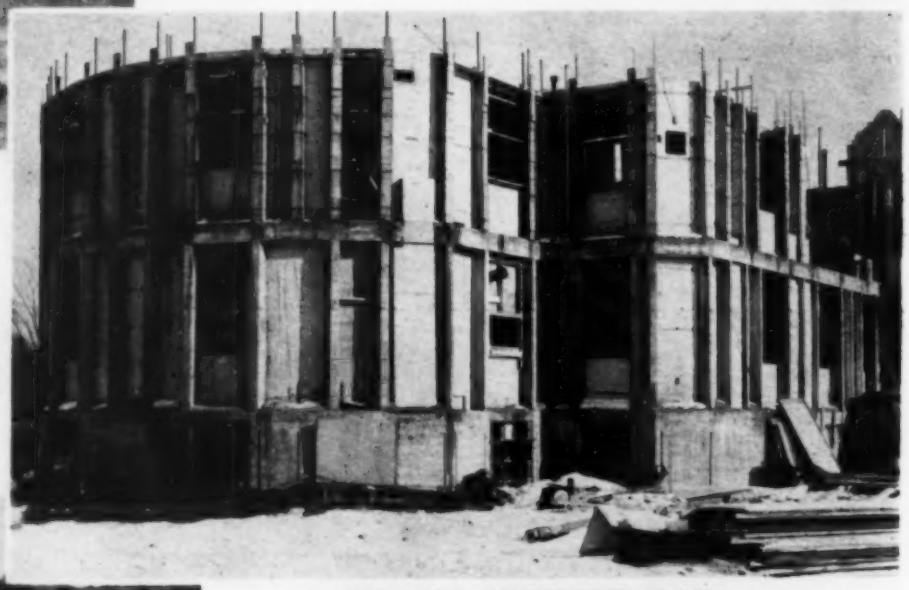
"EMPIRE OF THE WEST," a motion picture released by the Metropolitan Water District of Southern California, dramatizes man's conquest of the desert by the building of the Colorado River aqueduct along a 300-mi. front. In the prologue, dealing with pioneer days in California, the role of the early Californian is played by Leo Carrillo, motion picture actor. The picture, from which the accompanying "shots" are taken, illustrates in detail the methods and equipment employed in constructing the project's 108 mi. of tunnels, 63 mi. of lined canals, 55 mi. of conduits, 28 mi. of siphons, 155 mi. of distributing mains, in addition to various dams and pumping plants.

How They Did It—

CONSTRUCTION DETAILS FOR *Superintendents and Foremen*

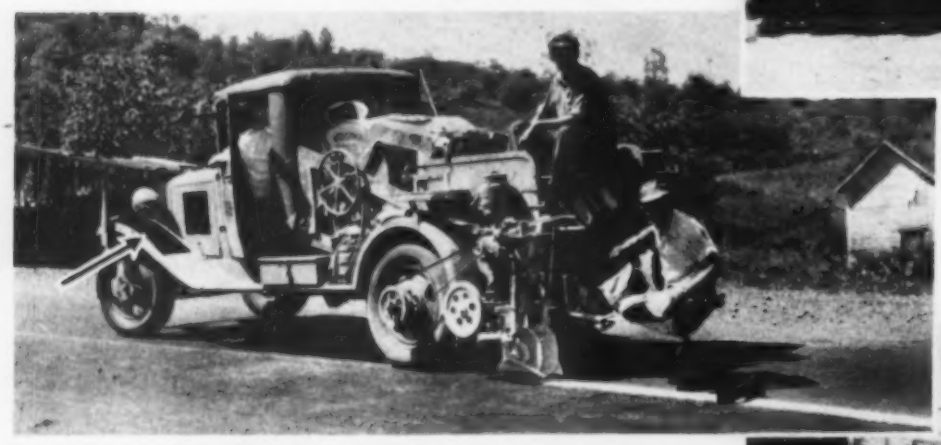
CAISSON HOLES,

later filled with concrete to form substructure foundation, are bored to diameter of 3 ft. 6 in. and depth of about 18 ft. through stiff clay to hardpan by rotary drill rig mounted on Marion gas-electric excavator at site of Apex building, under construction in Washington, D. C. by McCloskey & Co., builders, of Philadelphia, Pa. Rotating head, rigged near foot of 45-ft. boom, turns telescopic "Kelly bar" attached to open steel cylinder with cutting teeth both on bottom rim and also around top, latter to regulate size of hole. When filled with clay, rotating cylinder is raised and dumped. After excavation steel liners are placed in hole, leaving clearance for belling out at bottom. Holes are then filled with concrete. Rig illustrated completed 177 caisson holes in less than month under subcontract with Raymond Concrete Pile Co., for whom M. J. Moran was superintendent.



PRECAST CONCRETE SLABS

3 ft. 9 in. x 8 ft. 6 in., form interior surface of inclosing walls of apartment building in Detroit, Mich., designed by Talmage C. Hughes, architect, of Detroit, for John B. Terns, owner. Butted joints of slabs are erected on exterior forms for studs, which are 6 in. square, with 1¾-in. reinforcing rods in center. Exterior is then faced with furring channels and 1½ in. of portland cement mortar. Contractor, Ralph C. Vokes of Lithocrete, Inc.

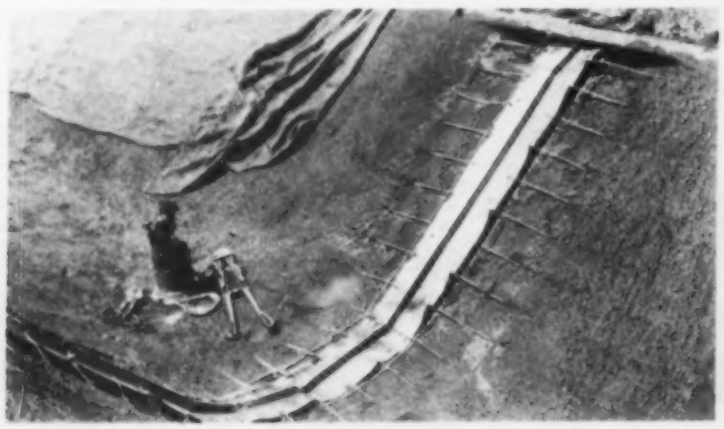


WINDOW IN FRONT FENDER

assists driver of Virginia Highway Department traffic marking truck in following old center-line stripe. Pump driven by belt from pulley on rear wheel of truck delivers traffic paint to applicator at pavement surface. Operator on low-hung rear seat controls flow of paint and drops bent red Z-plates on fresh stripe to protect it from vehicles. Plates are retrieved on return trip later in day. Man riding on top of truck puts plates in position for easy handling by operator.

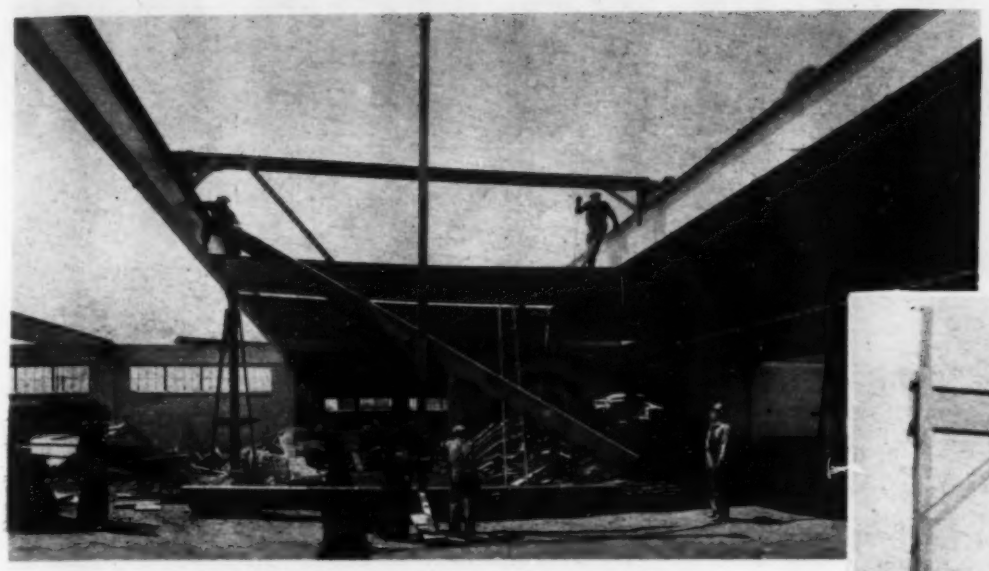
VACUUM-COMPRESSION FRAMES

are applied as forms to walls of concrete house at Bethesda, Md., to remove excess water from mix through hose lines to vacuum pump and to produce dense concrete through atmospheric pressure on frames. Process of Vacuum Concrete Corp., of New York City, is designed to increase strength of concrete and permit early removal of 4x8-ft. form panels. Walls were poured, forms stripped and exterior finish applied in one working day.



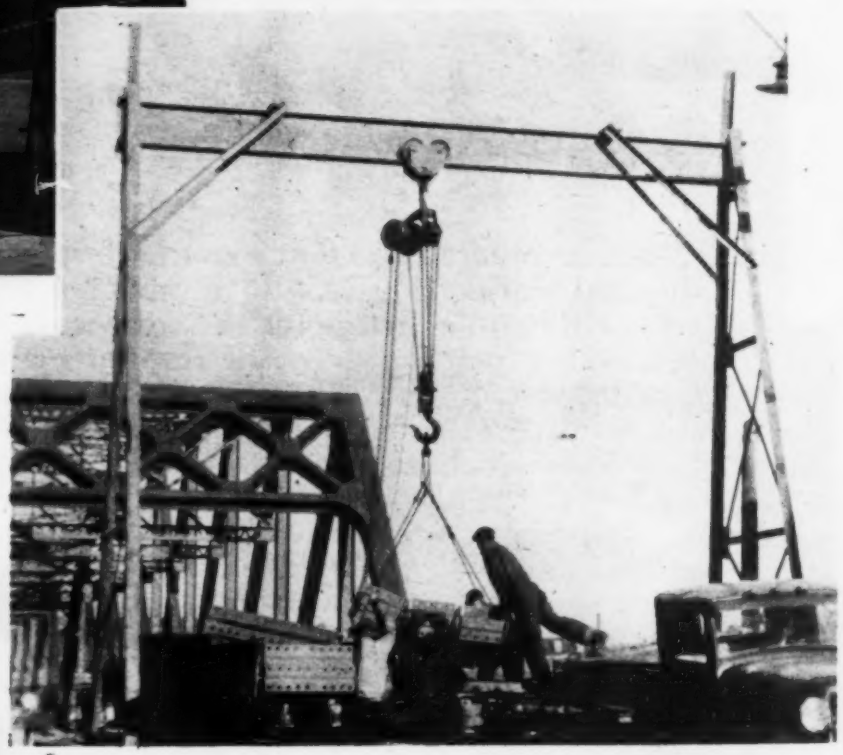
COPPER EXPANSION JOINT

is placed in Gunite lining of irrigation ditch in Hidalgo County, Texas. Joint is made by first building a batten 1 to 1½ in. thick and 18 in. wide below subgrade level. Over this batten of concrete or mortar is placed a layer of tar paper as a base for copper expansion joint.



GALLOWS FRAME

(below) unloads bridge steel from trucks by lifting load with slings and then moving it sideways, by means of trolley and chain hoist, on to material car running along rails directly over bridge stringers. Material car is pulled out on bridge by manila line from spool of hoisting engine on bridge erection traveler, which picks up steel members and sets them in place. Bridge across Juniata River at Mifflin, Pa., was erected by Bethlehem Steel Co. — *Photo from* WILLIAM G. RAPP, *Hewlett, N. Y.*

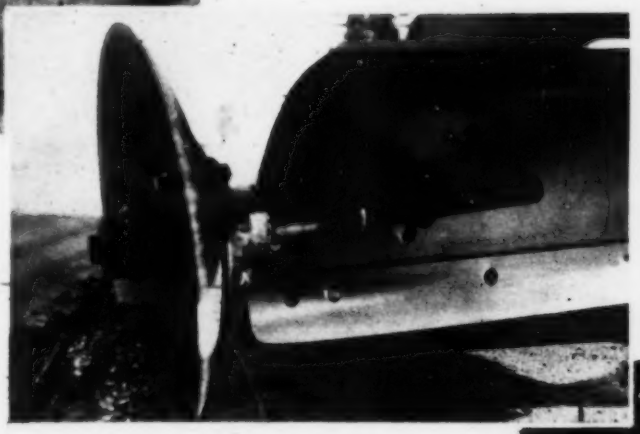


IMPROVISED TRAVELING CRANE,

an improvement on tedious hand-line methods, hoists 3x12-in. joists 25 ft. long, numbering about 800, on factory built by Willcox Construction Co., of Long Island City, N. Y., for P. & D. Mf'g. Co., of Astoria, N. Y. Crane, carried by castors running on building girders, comprises gin pole and winch. Two men on ground hook on, step on trailing platform at foot of gin pole to keep rig from turning upside down, and then "crank up." Cost of moving joists to place from saw was $1.50 per M. ft. b. m. Rig was devised by PETER OSTERLUND, superintendent *(left)* and JOHN HENRIKSON, carpenter foreman *(right)* — *Photo from* HENRY WILLCOX, *president, Willcox Construction Co., Long Island City, N. Y.*

EDGE-CUTTING ATTACHMENT

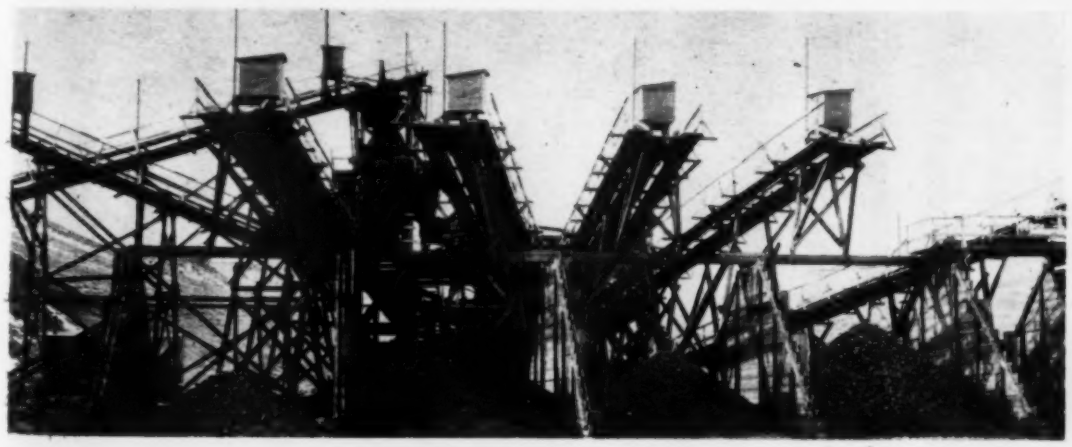
mounted on moldboard of power-operated blade grader *(above)* produces regular border line along plant-mix oil surface roads built without header boards in District 5 of California Division of Highways. Device, developed by J. C. Adams, resident engineer, and A. J. Raisch Co., contractor, consists of 24-in.-diameter farm disk *(right)* on roller-bearing hub of automobile axle with 20-in. shank bolted to grader blade by two ¾-in. U-bolts. Disk first cut true edge along earth shoulders to form lateral support for plant-mixed surfacing. Oiled surface edge was then cut again to form true border for oil-mix shoulders. A line stretched between points 400 ft. apart guided grader. — *Photo from* J. C. ADAMS, *resident engineer, California Division of Highways.*



WANTED — Photos of Details

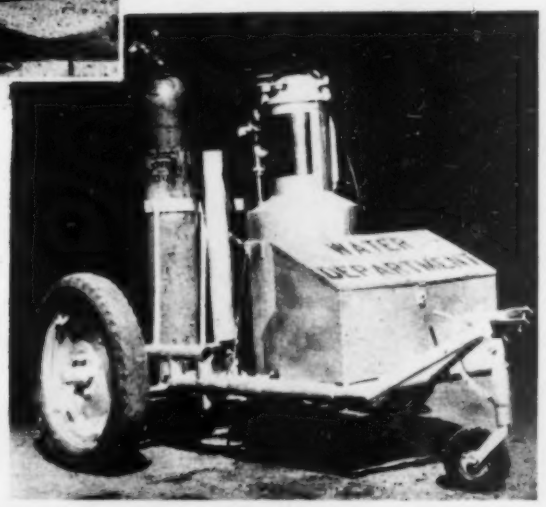
The Editor of Construction Methods and Equipment wants photographs or sketches illustrating interesting DETAILS of method or equipment and will pay for those he finds acceptable for publication.

Hasn't your job produced some DETAIL that might be illustrated on this page? Send along a picture of it; we'll return it promptly if we can't use it.



SAND AND GRAVEL PLANT

at Seminoe dam, U. S. Bureau of Reclamation project in Wyoming, washes and separates its first batch of aggregates. From plant material is moved 4 mi. by aerial tramway to concrete mixing plant at dam site.



OXY-ACETYLENE TRAILER

for welding is devised by water department of western city. Outfit of salvaged material, fabricated by blowpipe, carries one oxygen cylinder and one portable medium-pressure-type acetylene generator. Metal box houses regulators, blowpipes and hose. Small front wheel is raised off ground when rig is towed behind automobile. —*Photo, The Linde Air Products Co.*

ON CHICAGO'S $328,000,000 S

—Allis-Chalmers c

When completed, the four mammoth sewage disposal plants of the Chicago Sanitary District will handle sewage for the equivalent of 6,265,000 persons. Recent improvements scheduled will cost $200,000,000, bringing the total to $328,000,000. The $30,000,000 Southwest works alone (shown here) includes 38 acres of aeration and final settling tanks ... can carry a peak load of 600 million gallons daily ... will be the largest activated sludge plant in the world — and is being erected at the record low cost of $32,000 per million-gallon capacity.

As on so many other jobs where reliable performance, big output and low costs are absolutely essential ... contractors on the Sanitary District project have chosen Allis-Chalmers Tractors. T. M. White Company first purchased five wide tread "WK's" and a Model "L" ... then two more "L's" and another "K." Herlihy Mid-Continent Co. put four Model "L's" on the job. Hendriks Construction Co. selected a Model "L-O" and 10-yard Continental Scraper. Impressed by the outstanding performance of these A-C units, E. J. Albrecht Co. selected a Model "L" with 10-yard Continental Scraper and a Model "K" with Baker Bulldozer.

You, too, can depend on "cheaper-per-yard" performance from Allis-Chalmers tractors. Let the A-C dealer show you.

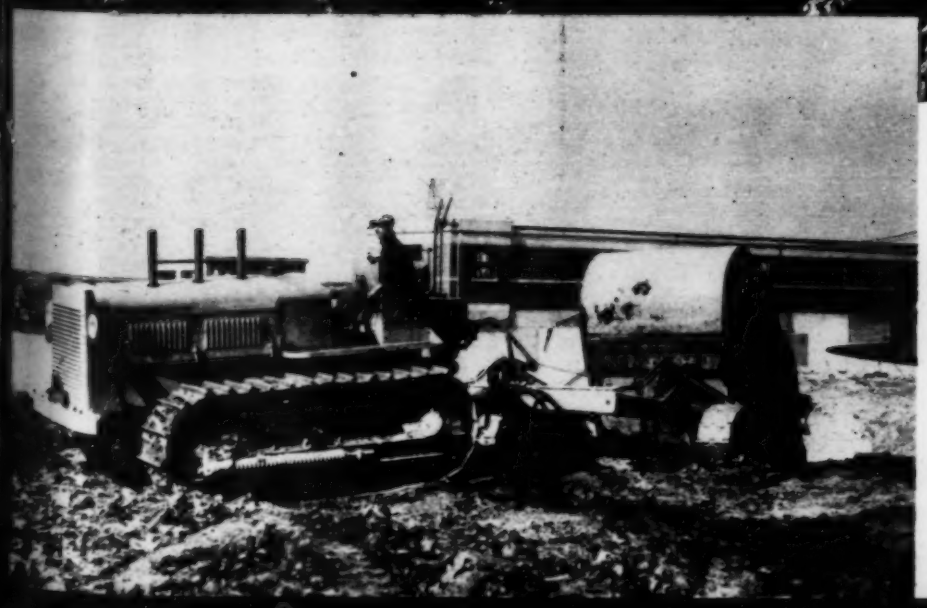
ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

Controlled Ignition OIL TRACTORS

SEWAGE CONTROL PROJECT

owners REPEAT!



CONTRACTORS "REPEAT" ON A-C TRACTORS

Once an Allis-Chalmers Tractor demonstrates its fast-stepping performance on a job, more are bound to follow. That's what happened on the Chicago Sanitary District project. Left to right are jobs of Herlihy Mid-Continent Co., T. M. White Co., E. J. Albrecht Co. (above) and Hendriks Construction Co. A-C owners "repeat."

Man-Hour Costs

on Grade Separation Contract

A GRADE SEPARATION involving two plate girder spans carrying individual railroad tracks across a depressed highway in a Mid-Western state went to a successful bidder who submitted low bids for the two contracts into which the work was divided: (1) the railroad overhead and (2) grading and draining 0.303 mi. of highway. The contract contained no requirement with respect to man-hours of employment. Total payments to the contractor on the two contracts amounted to $174,841.76. Labor used on the project totaled 70,359 man-hours, and total wages amounted to $41,596.84. A breakdown of these items by classes of labor is given in an accompanying table of labor costs.

In a second table, labeled Material Costs, is recorded a partial distribution of $112,852.25 expended by the contractor for materials incorporated in structures on the project. The breakdown is incomplete, as indicated by the miscellaneous item of more than $52,000. Although labor records in the accompanying table are accurate to the last decimal point, similar accuracy cannot be guaranteed for the materials report. The motor fuel item, for example, is given as $212.52, although the actual fuel cost on a project of this size must have been close to $2,000. For some reason, possibly because hauling equipment may have been rented with all operating costs paid by the owner, the contractor reported a small outlay for fuel purchases.

It is to be noted that the costs given in the tables refer *only* to wages and to materials expended in building the grade separation. These costs definitely *do not include* the many items of depreciation, rental, repairs, moving, insurance, taxes, overhead and profit which must be reckoned in the total cost of any job. After paying for labor and materials the contractor on the job in question had left $30,392.67 to take care of these numerous items.

Construction of the grade separation was carried out by a contractor of better than average skill, adequately equipped with plant to perform the work in the most efficient manner. It is instructive to observe that on a grade separation contract completed for slightly less than $175,000 this contractor used (for each $1,000 earned) roughly 50 man-hours of executive, administrative and supervisory labor, 62½ man-hours of skilled, 24½ man-hours of intermediate and 266 man-hours of unskilled — a total of 403 man-hours per $1,000 earned.

Man-hour and material cost figures produced on this contract *cannot be applied successfully* to any other grade separation project, completed or contemplated, without due allowance for the numberless local factors which make every job a distinctive and individual problem. Warning is here given that any estimator who uses these figures without reservation in bidding on other work will meet with sad disillusionment.

CONTRACTS A and B, constructed by one builder, involve two parallel steel girder spans for railroad overhead and grading and drainage for underpass roadway and approaches.

Contracts A and B

(A) Railroad Overhead; (B) Grading and Drainage for 0.303 Mi. of Highway in Underpass and Approaches

LABOR COSTS

Classification	Man-Hours	Wages
Executive, administrative and supervisory	8,734½	$7,611.16
Skilled	10,916½	9,043.23
Intermediate	4,299	2,508.08
Unskilled	46,409	22,434.37
Total	70,359	$41,596.84

MATERIAL COSTS

Materials	Quantity	Total Cost
Portland cement, bbl.	2,304	$4,388.94
Gravel, cu.yd.	9,759	13,621.50
Sand, cu.yd.	3,875	4,921.05
Brick, 1,000	14.75	236.00
Structural steel, lb.	323,134	11,193.98
Reinforcing steel, lb.	99,878	2,337.54
Lumber, 1,000 b.-ft.	360	16,216.47
Steel piling, lb.	177,280	3,190.97
Concrete culvert pipe, ft.	6,542	4,052.92
Metal culvert pipe, ft.	390	324.60
Motor fuel, gal.	1,932	212.52
Miscellaneous materials		52,155.76
	Total	$112,852.25

Contract A . . . Railroad Overhead

Two Steel Girder Spans

QUANTITIES AND PRICES

Item	Quantity Estimated	Quantity Final	Unit Price	Amount Earned
Embankment for temp. tracks	Lump sum	100%	$ 3,000.00	$ 3,000.00
Trackwork—temp. tracks	Lump sum	100%	14,854.00	14,854.00
Maintenance—temp. tracks	Lump sum	100%	2,000.00	2,000.00
Removal of temp. run-around	Lump sum	100%	1,975.00	1,975.00
Grading—perm. tracks	Lump sum	100%	13,857.00	13,857.00
Trackwork—perm. tracks	Lump sum	100%	8,334.00	8,334.00
Replacing crossties—perm. tracks	600	600	3.75	2,250.00
Extending concrete R.R. culvert	Lump sum	100%	800.00	800.00
Cofferdams	Lump sum	100%	4,268.00	4,268.00
Temporary pumping	Lump sum	100%	500.00	500.00
Unclassified excavation, cu.yd.	1,440	1,440	2.00	2,880.00
Steel sheetpiling left in place, sq.ft.	7,128	7,128	.60	4,276.80
Concrete-substructure, cu.yd.	1,230	1,230	10.00	12,300.00
Concrete-superstructure, cu.yd.	108	108	15.00	1,620.00
Concrete-pump house, cu.yd.	127.5	127.5	16.00	2,040.00
Heating and housing concrete, cu.yd.	1,465.5	1,354.8	2.00	2,709.60
Cement, bbl.	2,220	2,220	2.50	5,550.00
Steel reinforcement, lb.	97,719	97,719	.05	4,885.95
16-oz. copper waterstop, lb.	395	395	.60	237.00
Rubbed surface finish, sq.ft.	7,600	7,600	.10	760.00
½-in. joint filler-cork, sq.ft.	62	62	.50	31.00
1-in. joint filler-cork, sq.ft.	6	6	.75	4.50
Fab. and erec., struct. steel, lb.	315,000	315,000	.05	15,750.00
Railing, lin.ft.	170.67	170.67	7.50	1,280.02
Membrane waterproofing, sq.ft.	2,800	2,800	.30	840.00
8-in. perf. C.M. pipe, lin.ft.	260	260	1.00	260.00
8-in. C.M. pipe, lin.ft.	127	127	1.00	127.00
Porous backfill—loose measure, cu.yd.	275	275	2.00	550.00
Misc. pump-house items	Lump sum	100%	250.00	250.00
Pump-house roof	Lump sum	100%	100.00	100.00
Pumping equipment	Lump sum	100%	3,500.00	3,500.00
Grade separation lighting	Lump sum	100%	1,800.00	1,800.00
Extras				
Cement, bbl.		76.5	2.50	191.25
16-oz. copper waterstop, lb.		30	.60	18.00
Structural steel, lb.		4,309	.05	215.45
Extra work				783.97
		Total, Contract A		$114,798.54

Contract B . . . Grading and Drainage For Highway

QUANTITIES AND PRICES

Item	Quantity Estimated	Quantity Final	Unit Price	Amount Earned
Removal of existing structures	Lump sum	100%	$500.00	$500.00
Removing old pavement, sq.yd.	6,700	6,582	.50	3,291.00
Removing sidewalks, sq.yd.	750	730	.20	146.00
Removing trees 13-24-in. diam., each	3	3	25.00	75.00
Removing trees 25-36-in. diam., each	1	1	50.00	50.00
Earth excavation, cu.yd.	46,000	46,000	.75	34,500.00
6-in. tile underdrain, lin.ft.	2,400	2,400	.50	1,200.00
6-in. sewer, lin. ft.	120	120	.75	90.00
12-in. sewer, lin.ft.	1,700	1,674	1.00	1,674.00
15-in. sewer, lin.ft.	300	294	1.10	323.40
18-in. sewer, lin.ft.	704	704	1.50	1,056.00
24-in. sewer, lin.ft.	82	79	3.00	237.00
36-in. sewer, lin.ft.	725	725	4.00	2,900.00
18-in. C.I. pipe culvert, lin.ft.	48	48	3.00	144.00
36-in. C.I. pipe culvert, lin.ft.	120	120	5.00	600.00
Manholes, each	8	8	100.00	800.00
Catch basins, each	7	7	75.00	525.00
Inlets, each	11	11	50.00	550.00
Porous backfill loose measure, cu.yd.	1,500	1,500	2.00	3,000.00
Steel reinforcement, lb.	107	107	.06	6.42
Concrete, cu.yd.	14.2	14.2	10.00	142.00
Cement, bbl.	21	21	2.50	52.50
Sodding, sq.yd.	8,200	7,504	.40	3,001.60
Seeding, mi.	0.30	0	100.00	0.00
Trimming and finishing earth grade, sta.	16.0	16.0	50.00	800.00
Extras				
Earth excavation, cu.yd.		4,355	.75	3,266.25
6-in. tile underdrain, lin.ft.		599	.50	299.50
18-in. sewer, lin.ft.		6	1.50	9.00
Porous backfill, cu.yd.		33	2.00	66.00
Extra work				738.55
			Total, Contract B	$60,043.22

Grand Total, Contracts A and B $174,841.76

WELL POINTS

Drain Lakefront Area

for Sewage Plant Excavation

By INSTALLATION of a well-point system, the Couse & Sanders Construction Co., of Detroit, Mich., was able to excavate for the Ludington, Mich., sewage treatment plant without the use of a cofferdam in water-bearing sand 22 ft. below the level of Lake Michigan and only 200 ft. away from the lake. A large brick building 20 ft. away from the excavation further complicated the situation. In conjunction with the soft sand, the proximity of this building presented a real problem.

Well Point System — Excavation for the plant's settling tank was about 60 ft. square. A 6-in. header pipe was placed about at water level, and well points were installed 3 ft. apart all around the excavation. To dewater the area through the points, the contractor connected a Novo 6-in. centrifugal pump to the header system. Accompanying photographs show the method of installation of the well points, the depth of the excavation and the dry working conditions at the bottom.

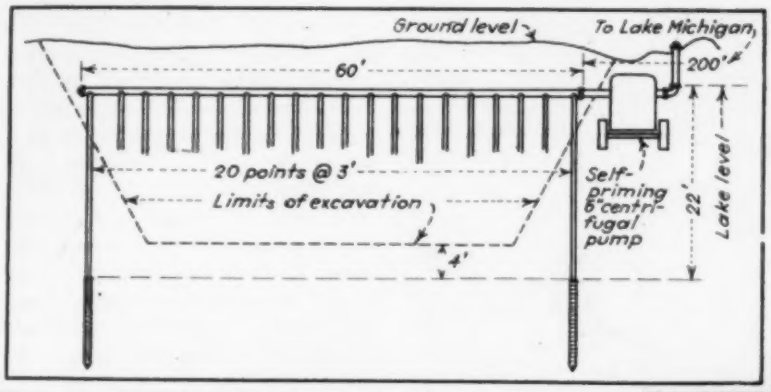
Well points, installed and put in operation on September 1, 1936, continued in constant operation until January 20, 1937. A duplicate 6-in. self-priming centrifugal pump served as a standby in case of accident to the first pump. The second pump was called into operation only 24 hr. during the whole period of the well point installation.

Success of the well point system was attributable to the ability of the contractor and to the dependability of the equipment used on the job. The slightest delay or shut-down would have spelled disaster, for the sand was of the quick-flowing type. Failure of the pump would have meant not only the immediate filling in of the excavation (in which the contractor had an approximate investment of $15,000) but also the possibility of the adjacent building's sliding into the hole.

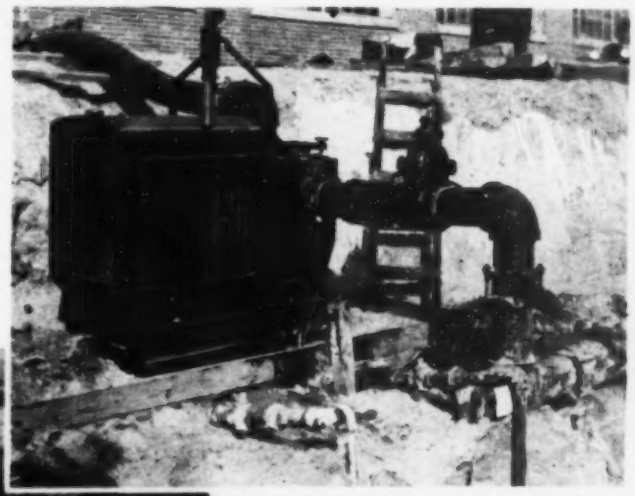
After removing 9,000 cu.yd. of earth, the contractor drove 8,300 sq.ft. of steel sheetpiling and 60 wood piles in the bottom of the excavation. Within the area protected by the well-point system, the construction crew placed 110 tons of reinforcing steel and 1,100 cu.yd. of concrete.

Administration—Ludington is a city of about 9,000 population. The contract for the sewage plant, valued at about $125,000, was financed through the aid of funds provided by PWA, represented on the project by Engineer-Inspector Lanigan. Completion of the plant was expected in April.

Ted Johnson, city engineer, was in charge of the work, and the consulting engineers were Ayres, Lewis, Norris & May, Ann Arbor, Mich. John C. Westphal, general superintendent, directed operations for the contractor.

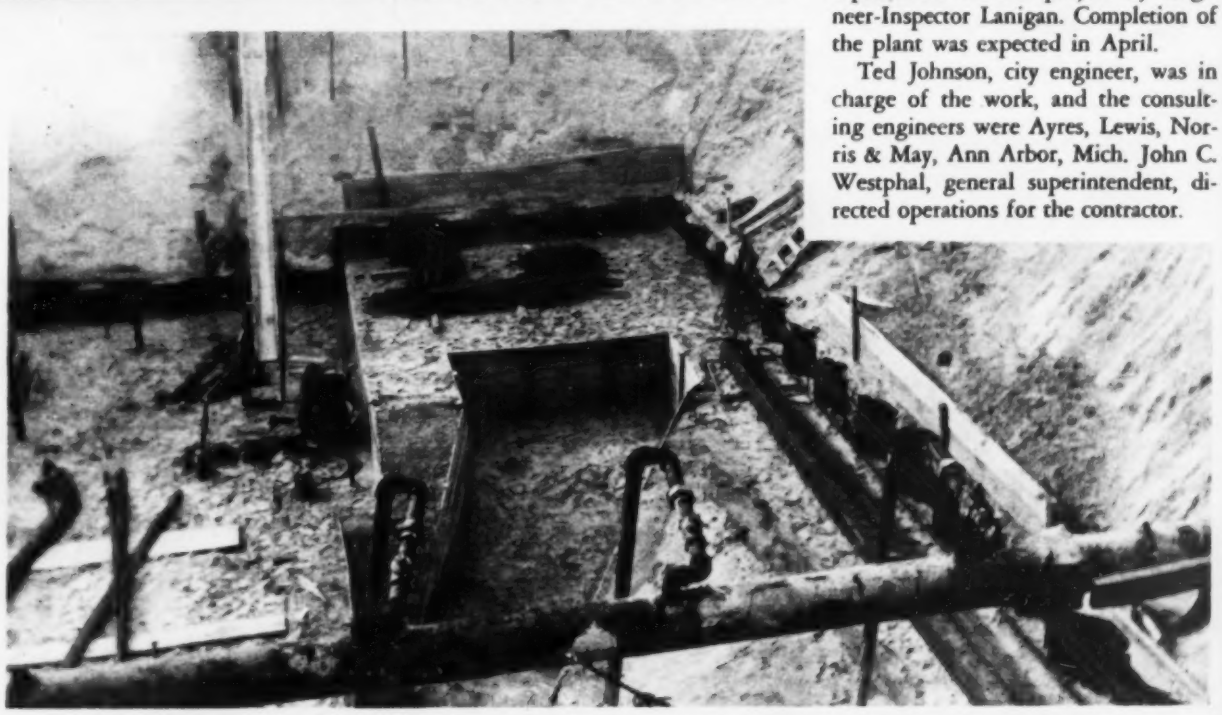


WELL - POINT SYSTEM *(left)* **hooked up to self-priming 6-in. centrifugal pump pulls down water level in sandy soil to 22 ft. below level of lake only 200 ft. away.**



SELF-PRIMING 6-IN. CENTRIFUGAL PUMP of standard type, without any special vacuum attachment, holds down water in 60x60-ft. excavation 22 ft. below normal level for almost 5 months.

PREDRAINING BY WELL POINTS permits dry excavation in quick-flowing sand to 18 ft. below groundwater level. Brick building at far side of excavation is 20 ft. from edge of hole.



IN BOTTOM OF EXCAVATION contractor installs steel sheetpiling and timber piles prior to placing concrete slab and footings.

Allied Construction Firms Start Work on

Marshall Ford Dam

FOUNDATION EXCAVATION for the Marshall Ford dam on the Colorado River of Texas, about 18 mi. upstream from Austin, the state capital, started in a serious way in April, when Brown & Root, Inc., and McKenzie Construction Co., of Austin, associated holders of a contract valued at $5,781,235, walked into the site three newly purchased 1½-yd. power shovels. In the same month the contractors completed erection of a stationary compressor plant and of sufficient camp buildings to house those workers who may wish to live at the dam. The Bureau of Reclamation, in charge of construction for the Federal Government and for the Lower Colorado River Authority, a Texas body building three dams for flood control and water conservation on the Colorado River with a $20,000,000 loan and grant from PWA, at the same time finished a camp for its representatives and started drilling to depths of several hundred feet in an effort to develop an artesian supply of soft and palatable water.

Several weeks in advance of the work on the dam foundations, the contractors began grading for a 13.2-mi. construction railroad which will provide freight access to the site. Rock explorations in the vicinity of the dam made it appear that for the 3- and 6-in. aggregates in the concrete the contractors probably would have to take crushed granite from near Burnet — a rail haul of 60 mi. For the first 10 mi. from its connection with an existing railroad, the construction railroad crosses a fairly level plateau where only clearing and light grading were required. In the last 3 mi. of route, the railroad drops more than 500 ft. from the plateau level to the river bank, on a grade of 3 per cent compensated. During April three power shovels of 1¼- to 1½-yd. capacity were at work on this part of the railroad grade.

MARSHALL FORD DAM will rise at this site on Colorado River of Texas. Path at left on opposite (west) bank of river indicates base line; central path crossing level land in foreground and climbing opposite bank indicates axis of dam. Horizontal white line on opposite bank marks crest of dam at El. 670. Water in stream is below El. 500. If high dam is ever built, axis will move about 100 ft. upstream, roughly to position indicated by third path at right on level land in foreground.

Features of Dam—Despite its bulk, involving almost 1,000,000 cu.yd. of concrete in a gravity structure with a maximum height of 190 ft. above rock foundation, the present dam is merely the first step in the creation of a larger dam which will rise 80 ft. higher and will increase the reservoir storage from the 600,000 acre-ft. now contemplated to 3,000,000 acre-ft. The present concrete dam is to be almost 2,300 ft. long, including a spillway 730 ft. long. This spillway, located in the river channel, has its crest at El. 640, about 160 ft. above rock foundation in the riverbed. The remainder of the dam has a top elevation of 670. At the east end of the concrete dam, the abutment connects with shallow earth dike which curves north about 1,000 ft. until it meets higher ground. The crest of this dike is at El.680.

Quantities—Excavation of dam foundations calls for estimated quantities of 450,000 cu.yd. of common excavation and 310,000 cu.yd. of rock. Concrete in the dam is estimated at 910,000 cu.yd. Reinforcement calls for 5,300,000 lb. of steel bars, while paradox (or "ring-follower") gates and

CONSTRUCTION RAILROAD drops more than 500 ft. in 3 mi. from plateau to dam site. Power shovels load blocky limestone broken up by blasting on this part of railroad grade.

operating mechanisms for 24 8½-ft. outlet conduits will weigh about 7,430,000 lb. Three 16-ft. diameter penstocks for power development require 1,150,000 lb. of steel pipe.

Construction Plant—A concrete plant equipped with four 2-yd. tilting mixers will be erected during June and July. Delivery is expected June 15. The plant will be equipped with automatic apparatus for recording the weights of the seven ingredients and the consistency of each batch.

Maximum productive capacity of the concrete plant will be about 2,200 cu. yd. in 24 hr. Concreting operations are to start by September 1. The contractors intend to average 1,660 cu.yd. a day and to complete the placing of 1,000,000 cu.yd. in 600 days. Contract time of 900 calendar days is allowed for completion, with a penalty of $300 for each day's overtime. Orders to proceed with the work were given Jan. 12, 1937.

A cableway stretching the full length of the concrete dam will deliver concrete from the mixing plant in an 8-yd. bucket. The track rope will be supported between a fixed head tower 196 ft. high and a traveling tail tower 100 ft. high. Fine aggregate and small sizes of coarse aggregate will be produced from a river deposit upstream from the dam. A steel-rope tramway will transport the material from the pit to the plant.

Administration — Activities of the Bureau of Reclamation are carried out under the general direction of John C. Page, commissioner, Washington, D. C., and Raymond F. Walter, chief engineer, Denver, Colo. Work on the Colorado River project is directed for the Bureau by H. P. Bunger, construction engineer, with C. P. Seger, resident engineer, in charge of operations at Marshall Ford dam. After completion the dam will be operated by the Lower Colorado River Authority, C. McDonough, general manager.

Principal officers of the associated construction firms are Herman Brown, president, and George Brown, vice-president, Brown & Root, Inc., and A. J. McKenzie, president, McKenzie Construction Co. Operations on the project are actively directed for the contractors by W. H. (Bill) Prentice, manager; E. M. (Ed) Whipple, superintendent; and R. M. (Bob) Dunham, engineer. All of these men have long records of successful construction experience.

FOUNDATION EXCAVATION *(below)* at east abutment starts with air from portable 360 c.f.m. compressor running four drills. Limestone formation composed of sound and decomposed rock in alternate strata breaks satisfactorily for loading. In background is elevated water tank of Bureau of Reclamation camp.

CONTRACTORS' CONSTRUCTION CAMP among cedars has dormitories and family houses connected to sanitary sewers of concrete pipe, adequate for 900 days of contract duration, laid in trenches cut through limestone rock.

Questions and Answers Clarify

WAGNER LABOR RELATIONS ACT

In response to inquiries following the Supreme Court decision on the Wagner Labor Relations Act, the National Association of Manufacturers has made public the following interpretations of rights and obligations under the Act:

QUESTION: Is an employee required to join a labor union?

ANSWER: No. He is not required to join or pay dues to any organization of any kind.

SENATOR WALSH of Massachusetts, who piloted the bill through the Senate, said: "The bill does not require or request any employee to join any organization of any kind, shape or character. It does not seek to encourage or bring about the establishment of any labor organization under any employer where there is now none."

QUESTION: If an employer should engage in collective bargaining with a labor union, must he agree to its demands? Must he reach an agreement of any nature?

ANSWER: No.

THE SUPREME COURT OF THE UNITED STATES says: "The Act does not compel agreements between employers and employees. It does not compel any agreement whatever."

Senator Wagner of New York, author of the bill, said: "It does not compel anyone to make a compact of any kind if no terms are arrived at that are satisfactory to him. The very essence of collective bargaining is that either party shall be free to withdraw if its conditions are not met."

QUESTION: Does the Wagner Act require closed shop agreements?

ANSWER: No.

SENATOR WAGNER said: "There is nothing in the bill which favors the closed shop. It provides merely that closed shop agreements may be made, but only in those states where they are now legal, by voluntary agreements between employers and employees."

QUESTION: May an employee elect to deal directly with his employer and not deal through a labor organization?

ANSWER: Yes.

THE SUPREME COURT OF THE UNITED STATES says that the Act does not prevent an employer from making such individual contracts as he may "elect to make directly with individual employees."

QUESTION: Can employees in a company organize or belong to an employee representation plan for the purpose of group action in dealing with management?

ANSWER: Yes. Nothing in the Act prohibits existence of representation plans confined to a single plant or employer. The form of organization is left entirely to the employee.

THE COMMITTEE ON LABOR OF THE UNITED STATES HOUSE OF REPRESENTATIVES said in reporting the measure: "Nothing in the bill prohibits the formation of a company union, if by that term is meant an organization of workers confined by their own volition to the boundaries of a particular plant or employer."

QUESTION: Does the Supreme Court ruling make it impossible for an employee to be discharged for failure to fulfill duties?

ANSWER: No.

THE SUPREME COURT says: "The Act does not interfere with the normal exercise of the right of the employer to select his employees or to discharge them."

Planning and Plant for

EIGHTEENTH OF A SERIES OF ARTICLES

HEAVY CONSTRUCTION

Principles and Practices of Job Layout and Selection and Use of Equipment

ADOLPH J. ACKERMAN and CHARLES H. LOCHER

Construction Plant Engineer — TENNESSEE-VALLEY AUTHORITY, KNOXVILLE, TENN. — *Construction Consultant*

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Special Foundations

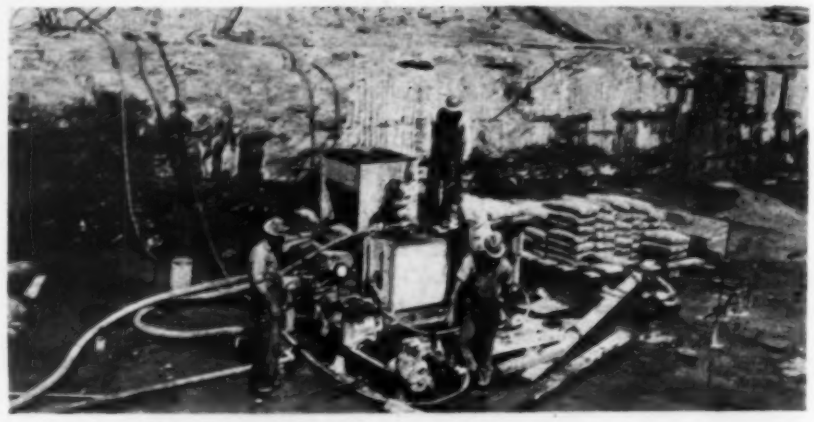
Grouting, Piling

and Caissons

ONE OF THE most complicated phases of heavy construction relates to proper treatment of the foundation to develop adequate stability for the superimposed structure. This applies particularly to hydraulic structures where surface water, ground water, seepage or various forms of instability of earth or soil are involved. In the case of a dam subjected to vertical and horizontal loading, as well as uplift, the necessary preparation of the foundation to resist these forces is sometimes exceedingly difficult. Seepage may appear to be of minor importance at the moment, but if acting over a long period of time it may be a major factor leading to the eventual destruction of the dam.

Careful planning is of extreme importance in dealing with foundations because in many cases the work is entirely underground and there is no obvious indication of accomplishment or any visual evidence of the money spent. A drilling and grouting program, for example, may cost several hundred thousand dollars, but after the work is completed there is no evidence of it ever having been done, and only long periods of time will disclose the effectiveness of the expenditures.

The foundation constructor must treat with many unforeseen contingencies and hidden forces. Unless he has thoroughly planned and investigated every step of his operations, he may suddenly discover that he is faced with failure and his work must be either done over or abandoned. For example, on one project the excavation was carried along well ahead of construction and when the unsuspected forces of the sun's heat came into action, and the newly exposed surface was subjected to temperature changes from day to night, the surface spalled and became unsuitable for resisting the sliding forces on the dam. At the same time the exposed rock face which, for centuries, had been subjected to the pressures of superimposed earth and rock, contained internal stresses which were finally being liberated, and this caused the rock structure to crack. A deep cutoff trench had been excavated, as required, and provided the necessary freedom for the exposed rock layers to expand and shear along a plane on a level with the base of the trench. This new fracture also destroyed the ef-



GROUT MIXER and pump, as used at Norris dam.

CENTRAL MIXING PLANT for clay grouting at Madden dam.

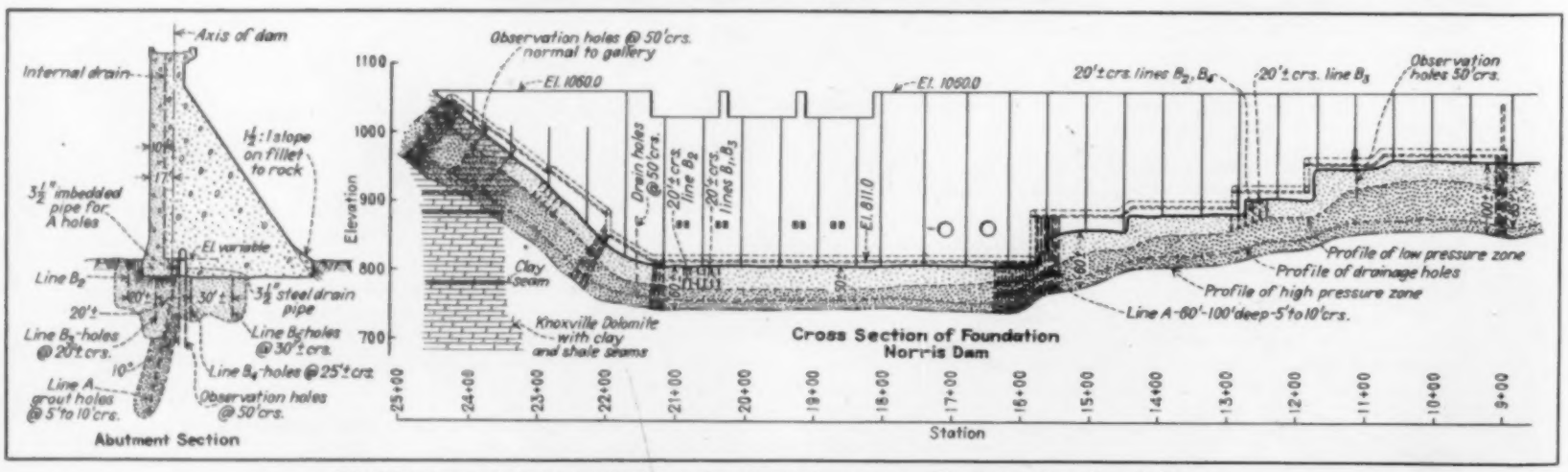


DIAGRAM OF GROUT CURTAIN under Norris dam to cut off seepage through rock fissures.

NOTES — "A" Line — Holes for grout curtain spaced at approximately 5- to 10-ft. centers, minimum depth 60 ft., minimum diameter 3 in., grouted from gallery through imbedded 3½-in. pipe under high pressure. Maximum pressure, 150 lb. per square inch. Drill and grout holes at 10-ft. centers before drilling and grouting of holes in between . . . "B" Holes — Holes for near surface blanket grouting, drilled with jackhammers before concrete is placed. Maximum depth, 30 ft. Grouted under low pressure (30 lb. per square inch). Spacing and depth of holes to be varied to suit rock conditions . . . Drain Holes — 3 in. minimum diameter, 30 to 85 ft. deep at 50-ft. centers, drilled from gallery through imbedded 3½-in. pipe after high-pressure grouting is completed . . . Pressure Test Holes — for foundation deformation gages and pressure tests. Holes must be drilled and apparatus installed before completion of galleries in concrete . . . Wash out all drill holes before grouting.

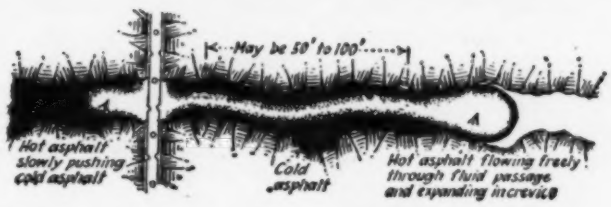
fectiveness of the rock to support the horizontal forces on the dam and made it necessary to excavate over the entire area down to the base of the cutoff trench. The new trench was thereafter excavated only as it was feasible immediately to refill it with concrete.

In the construction of a dam it is well to keep in mind that the river may originally have found its bed by scouring down through a fissure in the rock formation, and when the bed is finally exposed a continuation of that fissure may still be in evidence. In such cases it is important to clean out any disintegrated or broken rock along the shear zone and to refill it with concrete and high-pressure grout to prevent any possible undercutting or destructive seepage in the years to come.

Grouting

Even in so-called sound rock formations there are many seams and crevices through which water from the reservoir can percolate after the dam is built. It has become almost universal practice of late to grout such seams carefully for two purposes: 1, to prevent underground water passages; 2, to render the foundation impermeable and thus reduce hydrostatic uplift under the dam. As a rule the fissures and major seams in the rock structure have been located in advance by means of exploratory drilling, and the grouting is directed to seal such openings most effectively. This is generally carried out, as in the case of Norris dam, by first grouting, in advance of dam construction, the upper strata of rock under low-pressure of 30 to 50 lb. per square inch, to consolidate the upper structure. After the base of the dam has been constructed, deep holes are later drilled through the upper grout curtain down into the underlying strata and these are filled with grout at higher pressures up to 150 lb. per square inch. In some cases where there is no danger of lifting the strata or otherwise deforming the rock structure, pressures up to 500 pounds per square inch may be used. Uplift gages should be installed to indicate any tendency for the surface rock to lift when applying a high pressure over an extensive area.

CREVICE in Owyhee dam foundation is prepared to receive concrete. Shafts are left for additional excavations underneath.


May be 50' to 100'
Hot asphalt slowly pushing cold asphalt
Cold asphalt
Hot asphalt flowing freely through fluid passage and expanding increvice

ASPHALT GROUT entering a rock fissure.

THIN CONCRETE WALL with steel sheetpile extension down into earth 30 to 40 ft., serves as seepage cut-off for sand dam.

The consistency of the grout depends upon the size of the seam or cavity. For fine seams 1 part of cement to 10 parts of water (by volume) may be required to obtain penetration of the grout. Normally, a mixture of 1 part cement to 1½ parts water is most effective. In larger seams a 1:1 mix, or even ¾ parts water to 1 part cement may be used. In most cases it is best to use finely ground cement passing a 200-mesh sieve and, in any case, the cement should be screened through about a 28-mesh sieve to take out lumps.

Pumping into a hole should be continuous, as short stoppages will allow plugs to form and the seams to be sealed prematurely. In all cases the grout must be applied at a point below the overburden where the grout pipe may be effectively sealed into the rock so that no back pressure or loss into the overburden develops.

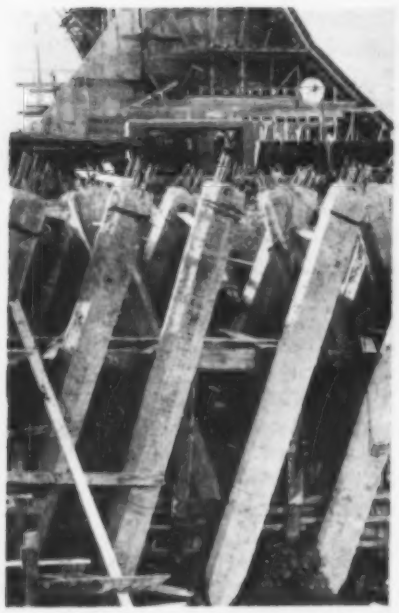
A grout mixer usually has two compartments, one for mixing a charge and the other to hold a fully-mixed charge which is fed to the pump. The mixed material must be continually agitated during pumping. The pump should be equipped so as to furnish a steady and dependable pressure and supply and be capable of pumping against various pressures. Hose is more suitable than rigid pipe for handling grout. Lines are normally about 500 ft. long, but may be increased to 800 ft. in cool weather. The rate of pumping grout depends on so many conditions that no rule can be established, but, in general, between 25 and 50 cu.ft. of grout can be pumped per hour within the pressure range of 25 to 150 lb. per square inch.

In some cases, for economy, it may be desirable to mix a cheap filler material with the grout. Sand is generally unsuitable for thin seams. For grouting the reservoir rim at Norris dam James S. Lewis devised a successful method of utilizing a rock flour by-product from the aggregate crushing plant. This material was thoroughly mixed with water and added to the cement and water mixture in the grout mixer. The mix usually consisted of 2 parts cement, 2 parts rock flour, and 5 parts of water, proportioned by volume. Three per cent of calcium chloride was added to hasten the setting. Careful tests should precede the use of any such filler material to determine its suitability in the mix and in the hardened product.

At Norris dam some of the horizontal seams in the rock contained in their natural state fine layers of clay, varying from nothing to 2 or 3 in. in thickness, and it was necessary to clean out this clay before grout could be injected to cement the two layers of rock together. This removal was accomplished by a novel system of washing the seams. Three or more adjacent drill holes were arranged so the outer ones were connected to an air supply

FROZEN EARTH DAM holds back slide of unstable earth at Grand Coulee dam.

PNEUMATIC CAISSONS are sunk through unstable earth to serve as continuous corewall to cut off underground seepage on Quabbin dike in Massachusetts.



REINFORCED CONCRETE PILING supports Imperial dam on Colorado River.

and the center hole to water under pressure. By reversing the direction of air in the feeders, the surging of the water loosened the mud and other materials and the pressure forced it out through adjacent holes.

As a rule, grouting technique is highly specialized and requires the development of a variety of special equipment to suit the particular conditions. At Norris dam, for example, the use of a 36-in. core-drill holes was introduced to permit visual inspection of the original formation and later to check the effectiveness of the grouting. Furthermore, a grout mixer and rock flour mixer of special design were used as well as seam-washers, mechanical and visual periscope explorers and seam locaters, electrical explorers and seam locaters, special packers and expanders for connecting the pipe which carries the grout to the rock structure and upheaval gages.

Clay Grouting

At Madden dam in the Canal Zone the permeability of the limestone along the ridges of the reservoir rim made extensive grouting necessary to seal large seams and solution channels which were usually not more than 5 to 20 ft. below the water surface when the reservoir was full. Most of these caverns were coated with a loamy sand and were of such size as to make cement or asphalt grouting unsuitable and too expensive. The presence of large quantities of clay directed efforts towards using it for grouting and after some study a satisfactory technique was developed. Clay and water were mixed in a 1-yd. mixer tank by an agitator and pumped into drill holes under pressure. The mixture, in general, was 55 per cent water (by weight) and was injected into the holes by air at a pressure of 110 lb. per square inch. Where the back pressure was lower, say from 50 to 85 lb. per square inch, a thicker grout containing 45 to 50 per cent water was used, and where back pressures were less than 50 lb. a very thick grout containing, in some cases, only 43 per cent water, was pumped into the holes. All holes were finally subjected to 300-lb. pressure applied by grout with 50 per cent moisture. Where the drill holes hit large caverns a thick partially-mixed grout was poured down the hole until it was filled, and then pressure was applied and a thick grout pumped until the desired back pressure was developed. Two pumps were used, one a double-acting piston pump, which developed up to 150 lb. of pressure and pumped thick grout through a 6-in. discharge line; and the other a high pressure pump capable of pumping through a 3-in. discharge at 300 lb. per square inch. In general, the clay grout consolidated well and formed a good bond with the walls or seams and caverns. Penetration in thin seams extended up to 50 ft. from the drill holes. On the Madden project, 70,000 cu.yd. of grout were placed at an average cost, exclusive of drilling, of $5.35 per cubic yard. Clay was delivered under contract at $2 per cubic yard and is included in the cost figure, the clay having special characteristics which made it more suitable than other materials obtainable at lesser cost in the immediate vicinity of the work. The plant capacity was 100 cu.yd. per 8-hr. day, under normal conditions.

The main disadvantage of clay grouting is that it is not effective in plugging seams containing running water and it has very little resistance to erosion.

LOOKING DOWN into Chicago type of open well shaft formed by timber and steel rings.

Asphalt Grouting

Asphalt grouting has been used to a considerable extent in this country and is better than cement grouting for fissures and broken rock where there is ground water flowing at an appreciable velocity. Asphalt is pumped into the ground as a hot fluid and solidifies under water in cooling. Asphalt is obtainable in many varieties from a thick fluid to brittle or oxidized grades. It is important that the right kind be used to obtain the most suitable consistency for grouting purposes. As a rule, the most effective asphalt grout is one which does not become hardened to brittleness, and yet becomes stiff.

Placing of asphalt grout is facilitated by a steam line running through the drill-hole liner or by means of a patented process, developed by G. W. Christians, consisting of an electric resistance wire suspended in the liner pipe, with the pipe completing the electrical circuit, thereby keeping the asphalt hot. This latter method provides assurance against plugged pipe-lines because, by turning on the current, any consolidated asphalt in the pipes can be heated up and grouting resumed. In some cases, this arrangement may be applied where the pipe is left in the ground for six months or a year, and if any further leakage develops the pipe may be reheated and the formation regrouted. The asphalt feed pipe is perforated at the lower end and grout enters the various fissures in the rock through these perforations. Hot asphalt is usually pumped in at pressures of 50 lb. per square inch and in a 2- or 3-in. seam it can be forced laterally from 100 to 200 ft. Some of the deposited asphalt, if of the type which does not completely solidify, can be moved further into the crevices after it has cooled at pressures of 200 lb. per square inch.

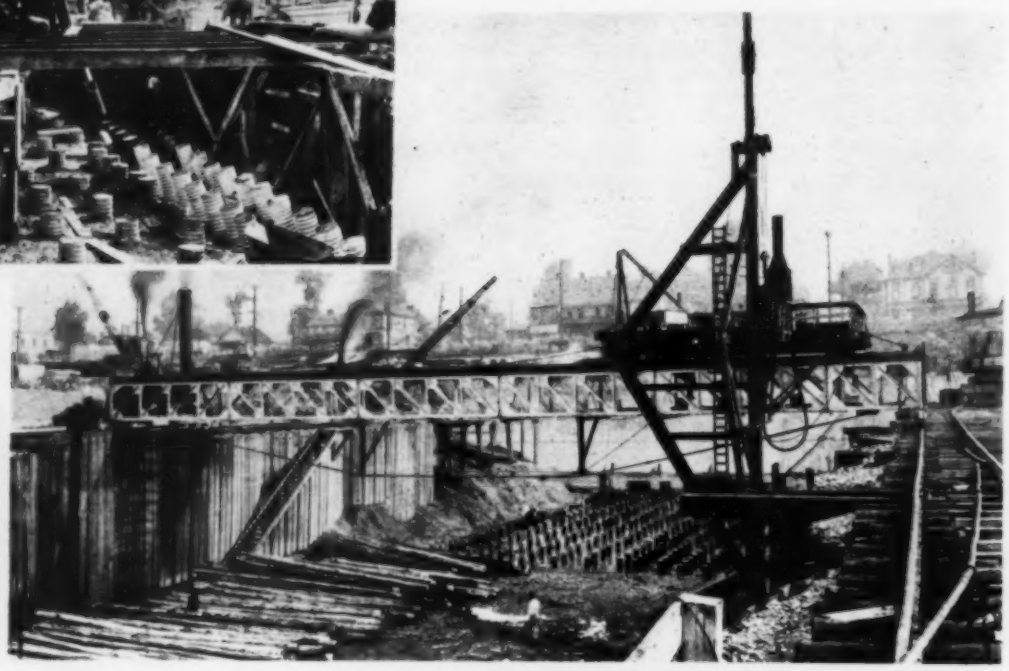
Special Materials

Sometimes the fissures are so large that special mixtures of a matted material and other binders are used first to fill the major part of a fissure or leak, and after the bulk of the water has been cut off a cementing grout is applied. The high expansion characteristics of volcanic ash have been used at times with considerable success.

Consolidation or Cementation Processes

There are two chemical processes which have been used successfully for consolidating water-bearing or loose formations. One of these is known as the Francois cementation process, a chemical treatment which usually precedes cement grouting in fissures, seams or broken rocks, using a special patented chemical compound. The chemicals used in pre-treatment form a colloidal precipitate which quickly sets and seals the fine cracks and openings, and lines large seams and cavities. The

STEEL CYLINDERS *(left)* are driven and filled with concrete to form Raymond type of piling.



SPECIAL RIG *(right)* drives timber foundation piling to support Allegheny River dam No. 3.

deposit serves to lubricate the surfaces and allow deeper than normal penetration of the cement grout.

A second chemical process, known as the Jorgensen process, is claimed to be particularly adapted to solidifying porous materials and overburden such as gravel, sand and broken rock into a concrete-like mass by injecting a sodium silicate solution followed by the injection of a salt brine or calcium chloride solution. This method has been used successfully in Europe and has recently been patented in this country. The following report has been given out regarding this process:

The chemicals will solidify under water, although water tends to reduce the range and effectiveness of the process. For use in fine, wet sand it is preferable to remove the water in the formation, if this is feasible. In large cavities this method of treatment is not applicable, as its action is in cementing or gluing material together and will not form large blocks of solid materials. Most chemicals used in these processes are heavier than water and they tend to displace it, thus making an effective seal in material carrying only a moderate amount of water. This process has been used successfully in solidifying material under bridge piers, the edges of deep trenches, and to develop a waterproofing for leaky concrete and masonry in tunnels and mine shafts. The cost of solidifying material is said to range from $12 to $22 per cubic yard, including drilling.

In Russia, the injection of a water-glass solution followed by a salt brine, sometimes containing cement, was used on the Moscow subway; this mixture was injected into a quicksand formation and caused the formation to solidify within 15 to 20 min. About 90 gal. of chemicals were used to a cubic yard of sand. Progress of solidification was at a rate of about 2½ yd. per hour.

Freezing Earth

A process of freezing used in 1933 for driving a 16-ft. shaft through quicksand for the Moscow subway in Russia has been carried to new developments recently in connection with the construction of the Grand Coulee dam on the Columbia River in Washington. The construction work there involved the removal of a large layer of overburden of glacial silt. This silt is a fine rock flour which, when wet, is fluid and has a slippery consistency. As the excavation proceeded part of the overburden began to flow into the working area, and this soon reached proportions where, without any treatment, it was estimated that from 30,000 to 200,000 cu.yd. of earth would slide through a deep rock gulch into the excavation area. After various methods of holding the impending slide had been considered it was decided to utilize the high moisture content of the material as a means of freezing the formation into an arched dam, abutting into a rock formation at each end, and thereby hold back the slide.

This arch dam of frozen earth, 20 ft. thick, 100 ft. long, and about 50 ft. high on a 105-ft. radius, is without precedent and was formed by driving 377 freezing points of 3-in. diameter pipe, averaging 43 ft. long, into the earth. These points were placed at 30-in. centers in both directions with about 25 extra points at each abutment, and were connected by 2-in. rubber hose. A salt brine was pumped into the points through 1½-in. pipe within the points, which conducted the brine to within 6 ft. of the bottom of the point where it was discharged into the 3-in. pipe and forced upward through the space between the two pipes and recovered at the top. While considerable movement of the arch during freezing was noted, no serious damage was done and the stability of the frozen dam was sufficient to hold back the slide. To relieve the dam of high fluid pressures, a drainage well was sunk 30 ft. in front of the arch; when excavation below the ice dam was completed, the water drained out by gravity, and the well was no longer needed. Two refrigerating plants were used with a combined capacity of 80 tons of ice per day, using ammonia as a refrigerant to cool the salt brine. The freezing was accomplished in less than 20 days. The arch dam was constructed at a cost of about $30,000, and this measure saved the cost of excavating about $100,000 worth of material.

Core Walls to Cut Seepage

Where dams are built on a glacial formation of highly porous gravel or sand a grouting or chemical process of consolidation is usually out of the question and, as a rule, a steel sheetpile interlocking cutoff is driven down from 40 to 60 ft. or sometimes 100 ft. or more into the ground. Extending above the ground surface is either a reinforced concrete core-wall or core of impervious clay which, together with the sheetpiling, forms a continuous diaphragm which lengthens the seepage path and reduces percolation through the dam to very small and unobjectionable quantities. One of the illustrations shows the simplest type of reinforced concrete core-wall as used on the sand dams in Michigan; another shows a special type of concrete core-wall which was extended down to rock on the Quabbin dam in Massachusetts. This dam and its location with respect to downstream communities was so important that a cutoff diaphragm extending to solid rock was considered necessary. The overburden was unstable and it was, therefore, necessary to build the cutoff by lowering cellular sections into place as pneumatic caissons which, after being interconnected and sealed at the bottom, formed an effective diaphragm across the valley.

OPEN-TYPE STEEL CAISSONS are sunk by simple method involving removal of muck with aid of small electric hoist.

BORING MACHINE, 6 ft. in diameter, with tubular telescopic shaft, is used at Detroit Post Office to drill holes 120 ft. deep through stiff clay for concrete cylinder piers. Drilling rate is 8 to 10 ft. per hour.

Special Foundations of Piling

In many cases it is necessary to relieve the surface ground formations of the duty of carrying a structure and transmit the loads to some underlying and more stable strata by means of one of several kinds of piles, or heavy piers. The most common type of piling is the timber pile, which has been used on such projects as the Alcona dam in Michigan, where piles 60 ft. long were driven at 2½-ft. centers over an area about 116x76 ft. to support a power-house structure in a quicksand formation. The driving was done from an overhead traveling bridge prior to unwatering; the water had to remain in place until all of the foundation preparations had been completed in order to retain the equilibrium of the earth formations and prevent upheaval of the quicksand. The piles extended through the quicksand to a coarse and sufficiently stable water-bearing sand.

SPECIAL RIG developed in New York for spinning down large caissons through unstable earth and clay.

On the Allegheny River Dam No. 3, about 4,420 piles were driven from a similar traveling bridge in the dry. The piles were located on 4-ft. centers in each direction through a 17-ft. deep overburden to support this navigation dam, as illustrated. Where a more permanent type of piling is required, reinforced precast concrete piles are used. In the construction of the Imperial dam on the Colorado River, now under way, more than 3,000 piles 45 to 50 ft. long were used, in this case battered in both directions to resist more effectively the horizontal and vertical components of hydrostatic forces. Concrete piles are generally jetted into place in combination with some driving, a jet pipe being cast in the center of the pile through which water under pressure is fed to its tip.

An effective type of concrete pile which is particularly suited to soil formations which are of such depth and consistency as to make the driving of precast piles difficult has been developed in the Raymond concrete pile. This consists of a steel shell fitting over a heavy steel mandrel which absorbs the driving blows of a standard pile hammer as the mandrel and shell are driven to place. When the assembly has reached final grade the mandrel is withdrawn, leaving the empty steel shell to be filled with concrete up to

the top and developing a satisfactory and permanent concrete pile.

Open Shafts for Large Piers

Where the limited size of standard piles does not provide sufficient bearing power, and larger piers are required, these may be constructed in various ways, as shown in the illustrations. One of the older methods consists of the so-called Chicago well method, which is a simple means of manual excavation and sheeting of the circular face of a shaft by means of vertical timbering and horizontal steel hoops, which are wedged against the sheeting. The process of lining usually follows right behind the excavation as soon as depth has been reached for another section. Of course, the formation being penetrated must be stable enough to keep from rising in the hole. Other open shaft methods consist of sinking steel shells by driving them down with large pile hammers, or by a means of internal excavation, the earth being removed with a bucket and small hoist mounted on top of the shell.

Another method of making cylindrical pockets consists of driving a ring of steel sheetpiling by using either a slightly curved pile section, where a relatively small diameter is required, or the standard sections to drive a larger cylinder, the lower limit of diameter being the angularity between piles permitted by the interlocks.

More recently a very ingenious method has been developed for sinking large-diameter steel caissons through an unstable overburden by means of a spinning process. This method is called the Montee-Atwell patented caisson and has been used in New York on shells up to 60 and 70 ft. in depth, and from 4 to 8½ ft. in diameter. The cylinder is made of steel plate ⅜ to ½ in. thick, and at the lower end has a saw-tooth cutting edge which is specially faced with an abrasive metal. The cylinder is clamped by a watertight connection to a rotating head driven by a 125-hp. electric motor mounted on a skid rig with vertical leads 78 ft. high. The rotating head spins the cylinder through sand, clay, gravel, boulders, and timber. The inside of the cylinder is partly filled with water, and water is fed directly to the cutting edge through pipes welded on the inside face of the cylinder. This water aids cutting and is supplied under pressure of sufficient amount to overcome any tendency for inward caving of the foundation material. In other words, the caisson also dispenses with pneumatic equipment and can be used where such equipment was formerly essential.

The secret of this successful method consists in attaching the caisson to the rotating head with a slight eccentric setting so that, in rotating, the caisson sweeps with an eccentric motion. As a result, only the cutting edge actually encounters a great amount of resistance, as the remaining portion of the cylinder is barely in contact with the wall of earth surrounding the cylinder, since the eccentric motion cuts a hole larger than the diameter of the cylinder. Furthermore, water delivered through the rotating head rises on the outside and lubricates the walls, at the same time bringing up a large part of the earth from the inside. The cylinders are spun down at the rate of 12 to 20 ft. per hour, rotating at a speed of 4 to 11 r.p.m., and it is possible to sink a 65-ft. cylinder in 4 to 6 hr. as compared with 6 to 8 days in sinking a similar cylinder by pneumatic processes.

The development of this spinning method was preceded by the large-diameter churn drills used on the Hudson tunnel and the large-diameter auger borings for deep pier holes used on the Detroit Post Office.

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NEXT MONTH — Chapter 19 of the series on "Heavy Construction," by A. J. Ackerman and Charles H. Locher, to appear in the July issue will discuss other special foundations and large pier caissons.

On-the-Job Advertising-With Paint

AN ADVERTISING ASSET that a contractor can have on the job is equipment painted with a distinctive color that will identify him and at the same time act as background to make signs or lettering on his machines stand out conspicuously. Lettered signs on equipment serve as traveling billboards if painted with high grade bulletin colors having attention-commanding brilliance and a lustre that is resistant to the dulling effect of smoke, fumes, weathering and road grime.

No extra money is needed to get the most in attention value from a power shovel or a truck; it merely requires the foresight, when ordering new equipment or repainting old, to specify a color that has "character" and a brand of paint that can "take it." Otherwise, the equipment soon looks like old stuff and becomes a liability instead of an asset.

Boosting of worker morale also results from the good paint job. Attractive looking equipment arouses a spirit of pride and enthusiasm in the operators; they not only do more work with greater care, but they handle equipment in a better and a more efficient manner.

Furthermore, investment in equipment is substantially protected by a good paint job. In addition to the advertising power supplied by color, the paint job checks rust and corrosion in the equipment. Recent developments in a new type of synthetic primer especially formulated for this kind of service make possible worth-while economies in time and money because the fast drying properties of the primer, when applied, mean practically no interruption in the service of the equipment. This new primer is filling, adhesive and flexible. It can readily cover difficult surfaces-joints, boltheads, and places where moisture tends to collect.

Before repainting, it is essential that the surfaces of old equipment be thoroughly clean, because under the paint film there should be nothing which can promote corrosion. To adhere perfectly, the paint must bond firmly and intimately. A coat of the new tough synthetic primer helps it to do this. Over this type of primer, paint has excellent adhesion and even though abrasion may gouge the surface of the paint, it will not chip off and leave bare metal if the surface has been properly prepared.

A porcelain-like finish on equipment can be obtained by using the improved synthetic transport enamels. They are easy to handle, dry fast, have excellent build and produce a natural high lustre that lasts. An attractive appearance can be maintained because these finishes resist dirt and can easily be washed clean.

Photos, Sherwin-Williams

SANDING DOWN *(below)* surface of motor truck prior to repainting.

SPRAYING speeds up application of paint to equipment.

PAINTED NAME *(below)* serves as mobile advertising billboard.

Present and Accounted For~

A PAGE OF Personalities

KENFIELD HOUSING PROJECT

in Buffalo, N. Y., is being completed under field direction of ALAN H. KNIGHT, general superintendent for Fleischer Engineering & Construction Co., building contractor, of St. Paul, Minn. PWA project will house 658 families on 65-acre tract. Contract price, $3,999,400.

NEW STATE HIGHWAY ENGINEER

J. H. LAKE is the newly appointed state highway engineer of South Dakota, succeeding Fred Schrader. Mr. Lake held a similar position in 1931-32 and has recently served as WPA district engineer in South Dakota.

TUNNEL LINER

E. M. PENN, since graduation from the University of California, has had an extensive tunneling experience, including Hetch Hetchy, Coast Range, Colbrook (Massachusetts) and Shandaken (New York's Catskill Aqueduct). At present he is concrete superintendent for the West Construction Co. on the Monrovia tunnels of the Colorado River Aqueduct in California.

A.R.B.A. ASSISTANT

W. C. SLEE, *(right)* of Baltimore, Md., has been named assistant engineer-director of the American Road Builders' Association, with headquarters in Washington, D. C. His previous experience includes service with several leading construction firms of Pennsylvania and with one of the larger road-building material companies. He will devote his time to extending the association's specialized services to road builders throughout the various states.

ARKANSAS HIGHWAYS

since first of this year have been designed and built under general direction of JAMES R. RHYNE *(left)* new director of highways and secretary to State Highway Commission. Mr. Rhyne received his civil engineering degree from University of Arkansas in 1907. Since 1908 he has engaged in general engineering work, specializing in land reclamation. Until his appointment as director of highways he was active head of Rhyne Engineering Co., Little Rock, Ark.

TEXAS HIGHWAY DEPARTMENT

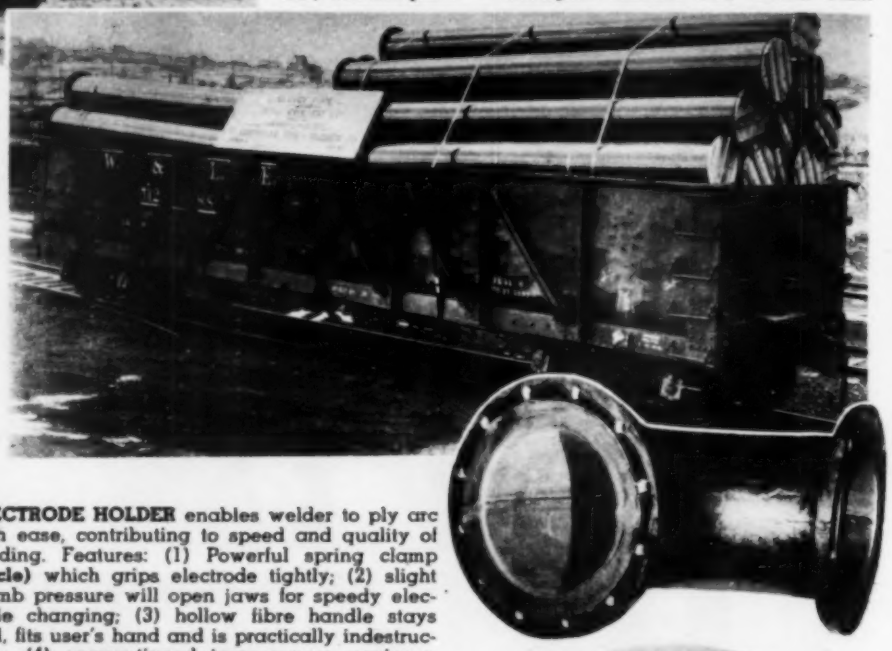
gathers its division engineers and department heads from far corners of Lone Star empire for periodic conference. *(Left to right)* E. G. FRANKE, assistant division engineer, Austin; T. E. HUFFMAN, division engineer, Lufkin; JIM DOUGLAS, Houston; JOHN B. NABERS, Childress; A. F. MOURSUND, San Angelo; T. W. BAILEY, Corpus Christi; J. W. PUCKETT, Pharr; J. G. LOTT, El Paso; M. C. WELLBORN, Fort Worth; GEORGE M. GARRETT; Lubbock; CLIFTON RICE, Dallas; W. A. FRENCH, Abilene; S. C. McCARTY, Atlanta; C. E. WOODWARD, Wichita Falls; MISS MAGDA P. CUENOD, official recorder for Texas Highway Commission; GIBB GILCHRIST, state highway engineer; W. D. DOCKERY, Del Rio; J. L. DICKSON, San Antonio; D. M. PUCKETT, Waco; JOHN E. BLAIR, Bryan; C. D. WELLS, construction engineer; F. S. MADDOX, designs engineer; JAMES E. PIRIE, Paris; M. B. HODGES, Yoakum; G. A. BRACHER, Beaumont; H. H. ALLEN, assistant to highway engineer; J. G. ROLLINS, chief engineer of construction and designs; HERBERT ELDRIDGE, bridge engineer; G. B. FINLEY, Pecos; W. J. VAN LONDON, Amarillo; D. C. GREER, Tyler; LEO EHLINGER, Brownwood. Personnel changes announced at this meeting transferred Mr. Greer from division engineer's post at Tyler to position of chief of construction and designs, succeeding Mr. Rollins, assigned to Dallas as division engineer. Mr. Rice of Dallas was assigned to El Paso, succeeding Mr. Lott, transferred to Tyler. Since meeting, Mr. Dickson and Mr. Maddox have exchanged posts.

Construction Equipment News

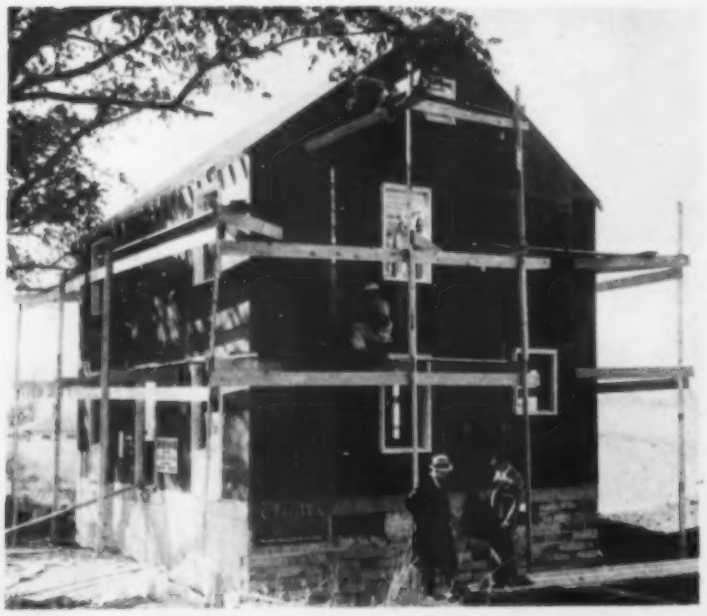
(All rights reserved)

Review of Construction Machinery and Materials for June, 1937

HEAVY-DUTY MOTOR GRADER constructed with five forward speeds, each variable by governor control so that practically any speed from 1 to 15 m.p.h. can be obtained, thus permitting operation for slow, difficult scarifying or high-speed maintenance. All-welded, box-type construction of frame and drawbar insures strength and rigidity, improves visibility of blade and permits wider range of blade adjustments. Powered by 6-cylinder, 59-hp. gasoline engine or by 62-hp. diesel engine, both of International manufacture. Supplied with 12-, 14-, or 16-ft. blade, with or without scarifier, and with dual-tired, two-wheel drive on rear or tandem drive with four- or eight-drive wheels.— **J. D. Adams Co., Indianapolis, Ind.**



RUBBER-LINED SLUICE PIPE (below) is used to transfer 3,500,000 cu.yd. of sand and gravel one-half mile in construction of Quabbin dam, PWA project on Swift River near Belchertown, Mass. Earth to be moved is in form of hilltop and with plenty of water available, transfer is made by sluice pipe and gravity flow. Frequent replacement of pipe worn out by abrasion of swiftly flowing mixture is avoided by lining entire pipe with thick, tough rubber. Fabricated pipe is fitted with rubber lining sealed to inner surface by Plioweld process. Lining is expected to triple or quadruple life of pipe, reducing expense and delay of replacements, thereby permitting 24-hr. operation. Job requires mile of rubber-lined pipe, most of it in 20-ft. lengths, 20 in. in diameter and connected by flexible combination steel and rubber ring joints. Photos show carload of pipe ready for transfer to job and close-up of rubber-lined section. Contractor, Benjamin Foster Co., Philadelphia. — **Goodyear Rubber Co., Akron, Ohio.**

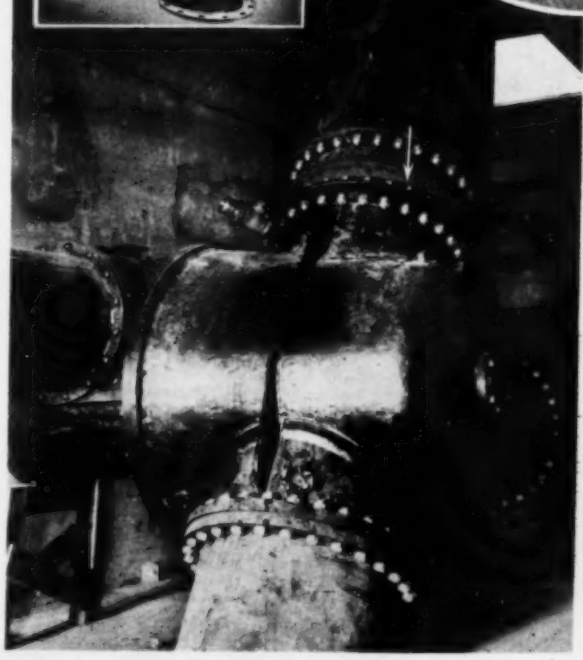


INSULATING BOARD (Celotex, 25-32-in.) for use as sheathing on outside and lath on inside walls of buildings has been improved by coating on both sides and on edges with moisture-resistant asphalt to increase insulating efficiency and on one side with reflecting aluminum compound to give vapor protection. Use of this specially treated board as sheathing assures stronger, tighter building, elimination of wind infiltration, adequate heat insulation and protection from moisture penetration. Used as lath, the advantages claimed are: Added bracing strength, cleaner plaster walls, less plaster cracks, high heat insulation and reduction of noise between rooms. Marked along stud placements to indicate where nails should be driven, facilitating construction and reducing application costs. Treated by Ferox process as protection against dry rot and termites. When used on both sides of framework Vaporseal Insulating Sheathing will constitute first step toward future air conditioning. — **The Celotex Corp., Chicago, Ill.**

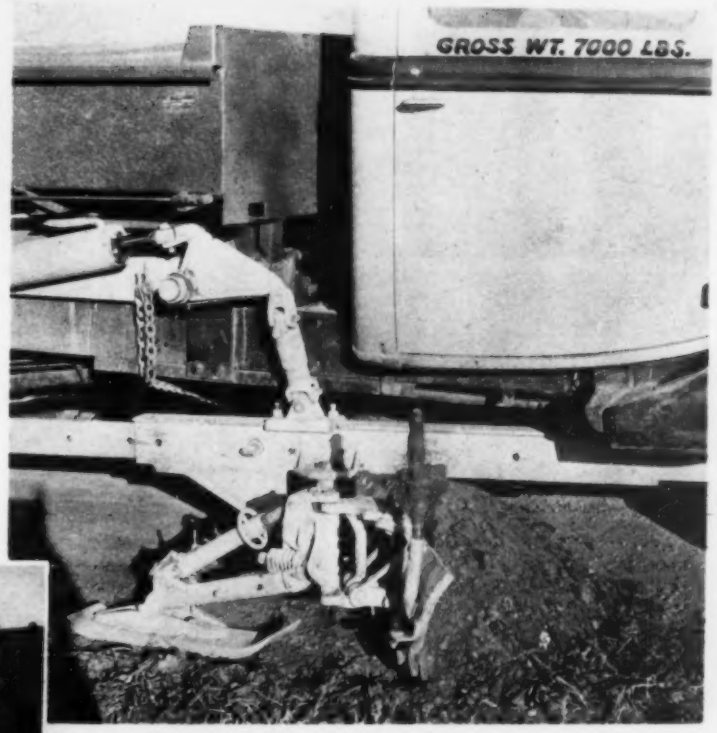
ELECTRODE HOLDER enables welder to ply arc with ease, contributing to speed and quality of welding. Features: (1) Powerful spring clamp **(circle)** which grips electrode tightly; (2) slight thumb pressure will open jaws for speedy electrode changing; (3) hollow fibre handle stays cool, fits user's hand and is practically indestructible; (4) copper-tipped jaws assure maximum conductivity and eliminate tendency of electrode to stick; (5) cadmium-plated metal parts; (6) cap screw can be tightened or loosened by inserting electrode in hole for leverage **(below).** Weight, 19 oz. Accommodates any size electrode up to and including ¼ in. and by slightly springing lever handles 5/16- or ⅜-in. electrodes. — **The Lincoln Electric Co., Cleveland, Ohio.**

TRAILER provides fast travel for Koehring ⅜-yd. shovel. Safety at all speeds, double rear axles and proper weight distribution are features pointed out by manufacturer. **Koehring Co., 3026 W. Concordia Ave., Milwaukee, Wis.**

CENTER-GUIDE CONVEYOR (below), for use in underground mining operations and for low-cost, long-distance transportation of mine products, has belt with continuous central guide strip molded on underside. This guide strip fits into groove in center roll of anti-friction idlers and enables belt to maintain central carrying position even when conveyor is tilted sidewise at considerable angle making side guide idlers unnecessary. Such positive and easy control is said to lengthen life of belt, eliminating destructive edge wear caused by keeping belt in line by conventional methods. Furnished for any width of belt and with double guides for wider belts. Particularly well suited for work in shallow seams and on uneven floor surfaces. — **Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.**



PIPE LAYERS, powered from rear take-off through ball-bearing mounted friction clutch of Caterpillar tractor, lift, lower, carry and bend pipe and serve as side cranes for other heavy duty lifting service. To obtain maximum lifting capacity with minimum counterweight, operating mechanism is located on opposite side of boom. Operation simple with all control levers within easy reach of driver. Other features: (1) Simple construction; (2) easy access to all parts; (3) unobstructed view for operator; (4) quick and easy mobility; (5) safety and complete control of load at all times; (6) three speeds in either direction for boom and load-line drums. Operation is independent of tractor clutch, saving wear on that part. — **Trackson Co., Milwaukee, Wis.**

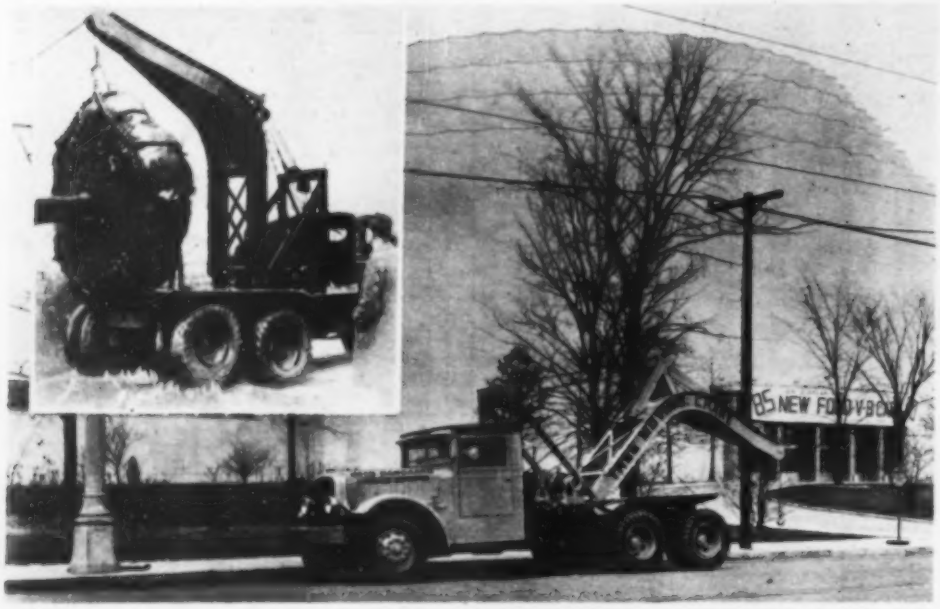


HYDRAULIC TRUCK PATROL equipped with cutting and levelizing mechanism for reshaping and smoothing roads, filling ruts and building up centers. Accurate adjustments permit close or deep cutting, as required. Hydraulic power to blade furnished by heavy-duty pump operated by power takeoff attached to truck transmission opening. Steadiness of blade is maintained at all speeds by action of hydraulic ram and levelizer. Angle of blade permits satisfactory cutting action with slight hydraulic pressure which in turn allows greater traction on tires and reduces slippage and tire and gasoline expense. — **St. Paul Hydraulic Hoist Co., 2207 University Ave., Minneapolis, Minn.**

SPECIAL RUBBER JOINTS are taking care of contraction and expansion due to frequent thermal changes on outlet and intake lines of a battery of centrifugal blowers recently placed at new Easterly Sewage Disposal Plant in Cleveland, Ohio. Largest blower has capacity of 40,000 cu. ft. per minute. Intake line on each blower has suction pressure of 10 in., water gage, and outlet has discharge pressure of 7½-lb. gage. In addition to absorbing movement of lines, use of these joints on outlets prevents vibration from being transferred from blower to distribution line. Arrow points to rubber expansion joint connecting blower outlet to distribution chamber. Inset shows group of joints, large ones for outlet and small ones for intake lines. Rubber specially compounded for long aging and resistance to continual flexing and reinforced with two-ply cord fabric. Joints on intake lines have added double wire reinforcement for withstanding collapsing pressure. — **B. F. Goodrich Co., Akron, Ohio.**

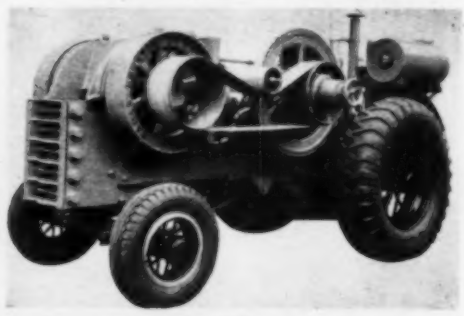
CARRYALL SCRAPER in 18-, 12-, 9- and 6-yd. sizes is equipped with expanding bowl and extra large tires which enable it to load 50 per cent extra yardage with practically no additional tractor effort. Bowl consists of two buckets, rearmost of which telescopes within forward one. When loading, rear bucket is carried back by return spring, thus expanding bowl capacity. Controlled by two-drum power unit mounted on tractor which draws scraper. Both front apron and tailgate manipulated through power unit to facilitate loading. Patented sliding tailgate forces discharge of all material, regardless of stickiness. High apron lift provides ample clearance for handling bulky material. — **R. G. Le Tourneau, Inc., Peoria, Ill.**

Construction Equipment News *(Continued)*



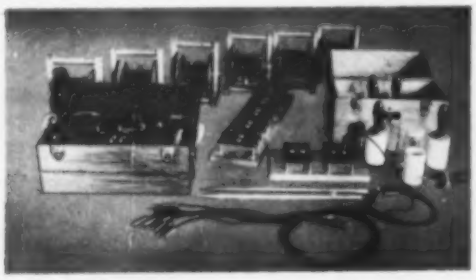
TREE-MOVING CRANE for handling large trees in highway and park landscaping will handle 45-ft. tree, which, including ball of earth around roots, weighs 18,000 lb. Crane is of goose-neck type, has live boom and is equipped with single-and double-drum winch. Single-drum winch capable of 20,000-lb. pull operates steel rope hoisting line fastened to chain mesh incasing ball of earth. One drum of double-drum hoist raises and lowers boom; other drum handles line attached to tree trunk. Both of these drums have pulling capacity of 15,000 lb. In removing tree, earth ball and roots are cut, wrapped and chained. Hoist line breaks tree away and lifts it. Boom raises ball of tree on to steel cradle for transportation. Tree line steadies and balances tree. Crane operator stands on lift running board at rear of cab and has complete control of unit at all times. Drums may be operated independently or together. — **Mead-Morrison Division, Gar Wood Industries, Inc., Detroit, Mich.**

FOUR MONSTER TRUCKS, each weighing 38,000 lb. empty and equipped with 25-cu.yd.-capacity steel dump bodies are at work for Phelps-Dodge Corp. removing 4,500,000 tons of overburden on Arkansas Mt. which adjoins corporation mining pit at Ajo, Ariz. Overall length, 26 ft. 3 in. Body height, 10 ft. 8 in. with dump lowered. Equipped with hand-and-foot control Westinghouse air-brakes and with warning sirens and flood lamps set in motion as soon as truck is placed in reverse gear. Powered by six-cylinder overhead valve engines. Five-speed transmissions and special chain drives. Dump bodies, 10½ ft. wide, 7 ft. high. Twin-telescopic hoists mounted outside frame and connected to body near front. Capable of carrying 40-ton loads. First week in service trucks carried fifty loads per 8-hr. shift. —**White Motor Co., Cleveland, Ohio.**



"ONE UNIT" ROCK CRUSHER has crusher, 35-hp. motor and heavy transmission built into one complete portable, heavy-duty roadside machine, with two forward and one reverse speeds. Ordinary capacity up to 10 cu.yd. per hour. May be adjusted for crushing from ¼- to 3-in. stone while in operation. Equipped with steel wheels or pneumatic tires. May be obtained with loading elevator. Weight, 12,000 lb. — **Eagle Crusher Co., Galion, Ohio.**

TO LOCATE UNDERGROUND ROCK, instruments known as Shepard earth resistivity meter and Lee geoscope determine, by electrical methods, depth and subsurface contours of rock strata, gravel beds, clay, shale and ore bodies. Applicable to any depth from 3 to 2,500 ft. Through use of Shepard meter engineers of U. S. Bureau of Public Roads have developed rapid technique that enables crew of only two engineers and two assistants to make from 10 to 20 shallow tests in one day. Lee geoscope is now in use with equal success by the U. S. Bureau of Mines. Method involves use of electric current flowing between two metal stakes driven into earth. Measurement of potential difference between two intermediate non-polarized porous cup electrodes, which are merely set down on bare earth (not buried or driven in) is accomplished by means of portable potentiometer. Complete equipment for Lee geoscope, illustrated above, includes potentiometer case (containing batteries), connecting blocks and cords, reels, current stakes and box containing potential electrodes. — **American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.**



TWO-STAGE PRESSURE REGULATORS for control of oxygen and acetylene in welding and cutting operations. Type R-64 is designed for operations requiring oxygen pressures up to 75 lb. per square inch; R-65 for heavy-duty cutting operations requiring oxygen pressures up to 200 lb. per square inch; R-66 gives accurate acetylene regulation and may be used with either oxygen regulator. Features: (1) streamline design; (2) steam-operated valves close with incoming pressure, not against it; (3) sensitive rubber diaphragms and self-contained first-stage valves; (4) bodies and caps pressure forged for adequate strength; (6) pressure-adjusting screw point cradled in three ball bearings to preserve exact alignment and provide finger-tip control; (7) handle of adjusting screw tri-spoked to provide effective grip for obtaining sensitive adjustment of delivery pressure. — **The Linde Air Products Co., 205 E. 42nd St., New York City.**

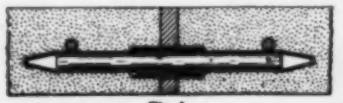


Fig. 1
Sectional View Through Concrete Slabs with Device in Position

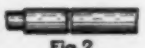
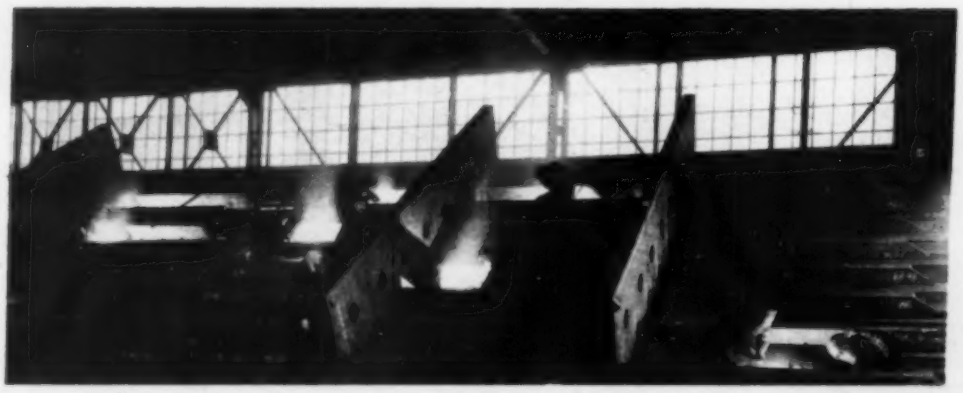
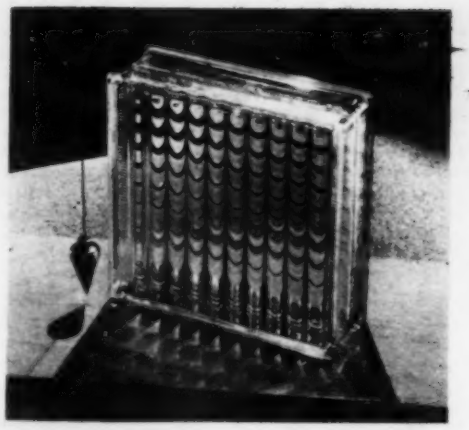


Fig. 2
Detail View of Tube Showing Groove for Holding Spiral Wire

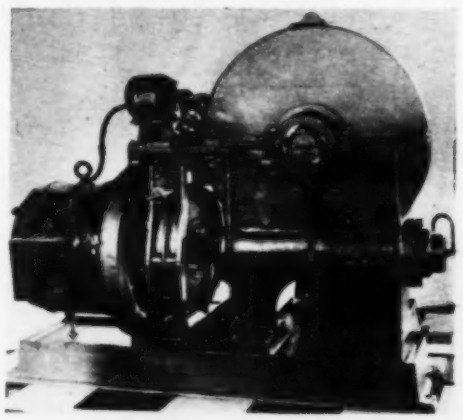
LOAD-TRANSMISSION DOWEL for use in expansion joints of concrete pavement comprises two tubes, each closed at one end, embedded in concrete of abutting slabs, working on steel dowel rod (Fig. 1). Gap between two tubes is closed by spiral steel spring anchored to grooves in tubes (Fig. 2) and protected from contact with concrete by asphalt covering. — **Inventor, A. S. Shafer, 5733 Ogontz Ave., Philadelphia, Pa.**



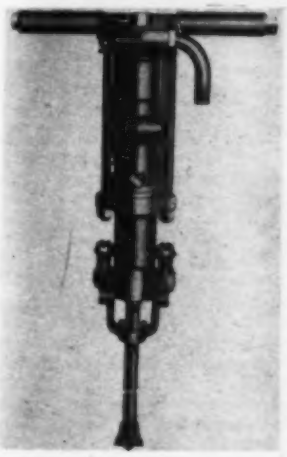
ELECTRODE, designed to simplify fillet welding and improve its quality, eliminates necessity of multiple pass welding in making these welds and permits production without undercutting or overlap. In one pass with electrode, fillet welds up to ⅜ in. in size with one plate vertical can be made. Of special advantage in all uses of fillet welding including shipbuilding, bridge and building construction, fabrication and manufacture. — **Lincoln Electric Co., Cleveland, Ohio.**



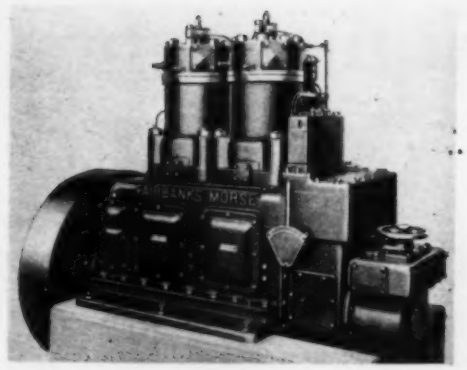
HEAT-RESISTING GLASS BLOCK made of same glass as "Pyrex" oven ware are manufactured for use on exterior of buildings where they are subjected to severe and sudden temperature changes. Hollow unit, 11¾ x11¾x4-in. in size, consists of two square dishes sealed together at high temperatures to form one homogeneous piece of glass, insuring permanence of block and preventing non-dehydrated air from entering interior and forming condensation during cold weather. Optical fluting, vertical on one inner wall and horizontal on opposite one, makes block completely translucent, transmits 78 per cent of light directed at one surface, cuts down glare or brightness of exterior light sources, produces soft, evenly distributed light throughout room and reduces cleaning problem to minimum. Unusually large size reduces cost of installation, and number of mortar joints increases light transmission and simplifies designing and estimating. Units set up with 1:1:6 lime-cement-sand mortar mixed as dry as possible. Weight of block 14 lb., packed four to a carton for shipment. — **Pittsburgh-Corning Corp., 748 Fifth Ave., New York City.**



TORQUE MOTOR-OPERATED BRAKE for hoists, elevators, and similar equipment eliminates solenoid control. Applied by spring and released by "torque" motor which can be stalled across line with full torque without overheating and excessive current. Advantages: Lower first cost; reduced maintenance expense and superior efficiency. Since motor continues to run at even speed till it stalls with brake fully released there is an absence of noise, jarring and vibration promoting long service. Torque motors standardized to produce any desired "on-and-off" operating cycle. Kimball Bros. Co. elevator shown above equipped with these brakes is installed at Alcova dam project, Casper, Wyo. — **Ohio Electric & Mfg. Co., Cleveland, Ohio.**



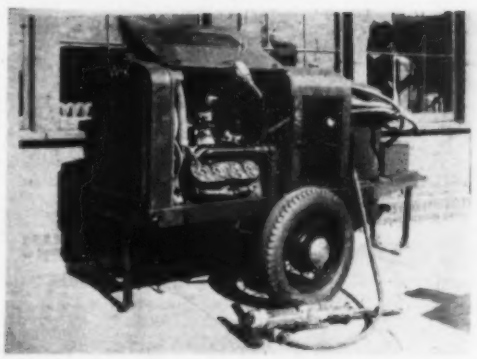
55-LB. COMPRESSED AIR DRILL for use in hard rock and deep holes in mine, quarry and contract work has improved valve which provides drilling speed of much larger drill and air consumption of much smaller one. Valuable for use with portable air compressors and in places where supply of air is limited. Weight, 56-59 lb.; length, 23½ in.; size of hose, ¾ in. — **Ingersoll-Rand Co., 11 Broadway, New York.**



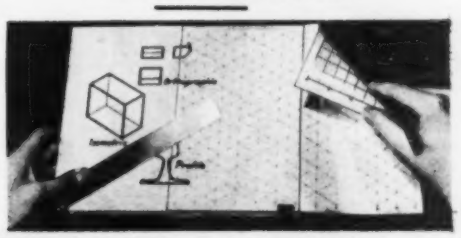
DIESEL STATIONARY ENGINE, heavy-duty continuous-service unit for small power users is available in two-and three-cylinder combinations with ratings of 60 and 90 hp. at 450 r.p.m. and with direct-connected, belt or electric generator drive. Bore 8¾ in.; stroke 10½ in. Small enough to be installed where space and head room are limited. Direct airless injection of fuel, two-cycle design with crankcase scavenging, and medium low speed are features that assure minimum of moving parts, reliability and low maintenance cost. Power impulse on each downward stroke gives uniform output without need of abnormally large fly wheel. Cylinder heads simplified by elimination of air inlet and exhaust valves. All working parts inclosed, yet readily accessible for inspection and maintenance. — **Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.**

PUNCTURE-PROOF INNER TUBE known as "Seal-O-Matic" tube, seals punctures in tires while car is in motion. Inner side of tube coated with layer of plastic self-sealing composition which closes hole without loss of air when penetrating object is removed. Product has been subjected to four years of actual road service, according to manufacturers, and users have reported removal of scores of nails, screws and other articles from tires after months of uninterrupted operation and without loss of air pressure. — **B. F. Goodrich Co., Akron, Ohio.**

ALUMINUM FOIL SHUNT for short-circuiting electric blasting cap wires consists of piece of aluminum foil 2½ in. long wrapped around bare ends of wires covering both wires and portion of insulation and preventing source of current from reaching bridge wire. Shunt will not shake off while caps are in transit. Removed easily, and without injury to hands, by spreading of wires. Manufacturer claims that this is much more efficient short-circuit than older types.—**E.I. Du Pont de Nemours & Co., Wilmington, Del.**

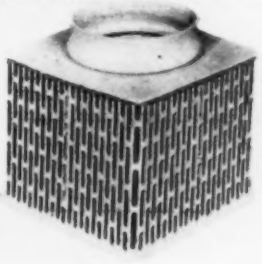


PORTABLE AIR COMPRESSOR adaptable to all types of construction, has Ford V-8 motor and W-K compressor head and valves. Combination intake and exhaust valve are in same cage, intake fitting inside of and serving as cooling device for exhaust. Outside of exhaust valve cooled by large water jacket in head assuring cool air at all times. Outstanding feature is serviceability in field, all parts being obtainable either in Ford agencies or distributors. — **Wenzel-Kenney Machinery Co., 229 Southwest Blvd., Kansas City, Mo.**



SKETCH PAD SET for making sketches to scale. Consists of pad of strong tracing paper and a cellulose covered buff guide plate that slides under top sheet of pad. This plate is printed in blue ink one side ruled in ⅛-in. squares, every ½-in. line heavy and every 1-in. line numbered. On other side is an isometric design with all three axes divided 1 in., ½ in. and ¼ in. so that drawings showing all six sides and interior may be made to any scale. Steel straightedge also provided. Pad has stiff back and is sealed at top with padding cement and at bottom with strips of re-usable drafting tape which prevent shifting. Made in pads of 200 sheets 5½x8½ in.; 100 sheets 8½x11 in.; 50 sheets 11x17 in. — **Wade Instrument Co., 1663 E. 119th St., Cleveland, Ohio.**

STEEL STRAINERS for self-priming pumps have extended inner tubes for complete drainage of tanks, sumps or construction pits, and are made larger because of increased efficiency of units which they serve. Sizes: 2 in. round and 3 in. to 12 in. square. All strainers 3 in. and over are made square with corners rounded to ¾-in. radius, thus increasing drainage surface area 25 per cent more than same diameter round strainer. Open area not less than five times suction, with no openings in bottom plate. Standard bell or bolted flanges, as desired. Open area of inner tube as well as clearance over bottom plate is 1½ times suction. All slots vertical and in following sizes: up to 3-in. strainers of No. 11 steel, 3/16x1½-in. straight slots; 4 in. and larger of No. 10 steel, ¼x2-in. staggered slots. Minimum width slot ⅛ in.; smaller sizes to order. Inner tube welded to top plate and on 4 in. and larger sizes also through center of each side panel making complete internal bracing and truss for top plate. Arc-welded construction gives maximum strength with minimum weight. After fabrication strainers are hot galvanized and threads carefully wiped. Folder giving prices on request. — **Rife Hydraulic Mfg. Co., 75 West St., New York City.**



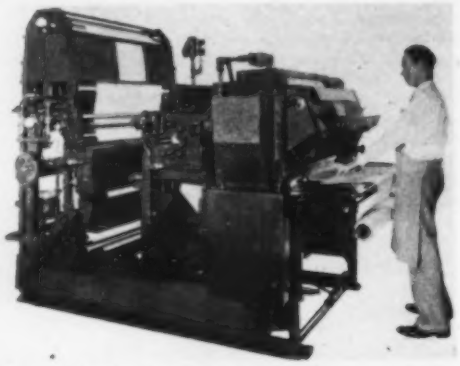
Construction Equipment News *(Continued)*

16,000-LB. TRUCK, lightest model in Mack Truck line, has full-crowned fenders with centerline crease; shallow valleys between fenders and hood; V'd and sloping radiator grille, and extensive use of chromium plating. Streamlined cab has all-metal roof, sloping windshield reducing glare, and safety glass throughout. Gasoline tank capacity, 20 gal. Available in four wheelbase sizes ranging from 146 to 194 in., and with three tractor wheelbases, 139 to 158 in. Maximum size tires, 8.25-20 in. Powered by six-cylinder engine with 3½x5-in. bore and stroke, with piston displacement of 288 cu.in. Develops 84 hp. at governed speed of 2,800 r.p.m. Drive is from dry single plate clutch through five-speed unit-with-engine transmission with direct drive in fifth as standard. Full-floating rear axles. Hydraulic and vacuum booster footbrakes.—**Mack Trucks, Inc., 34th St. & 48th Ave., Long Island City, N. Y.**

TABLE DRAWING STAND for engineers and draftsmen fastens securely to table of any size or shape by means of formed metal base and two rods, each bent at one end. In attaching, stand is placed on table, rods are pushed through base with bent ends close to sides of table, ends of rods are sprung down and end clips are slid under table. Release of pressure of hands from ends of rods causes clips to bind on rods keeping tension on base and securing it to table. Height and angle obtained by adjustment of two arms and brackets held by bolts and wing nuts. Sponge rubber tubing at all contacting points protects table. Light weight and folding capacity make it conveniently portable—**Westbrook Equipment Co., 10016 Greenview Ave., Garfield Heights, Cleveland, Ohio.**

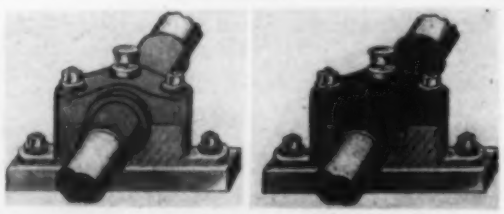
ALL-WELDED DIPPER, 5-cu.yd. capacity, is employed by Cleveland Cliffs Iron Co. of Hibbing, Minn., for stripping and digging iron ore. Made of tough alloy steels with full manganese lip and tooth points. All-welded construction reduces weight, permitting substitution for all-cast 4-yd.-capacity manganese dipper and obtaining 25 per cent capacity increase in machine without additional strain or sacrifice in operating speeds.—**Harnischfeger Corp., Milwaukee, Wis.**

BLUE PRINTING MACHINE is available in two models, either separately or in combination with washing, developing and drying equipment, to accommodate all widths of sensitized paper or cloth up to 42 or 54 in. in width in cut sheets or for continuous operation. Tracings and paper, fed in at front of machine, travel upward and around curved segment of highly polished glass where exposure is made by high-powered arc-lamps. After exposure, cut sheet sizes are returned to front of machine for hand washing, developing and drying. Continuous paper rolls travel into first horizontal water wash, next into developer, then into final spray-jet water

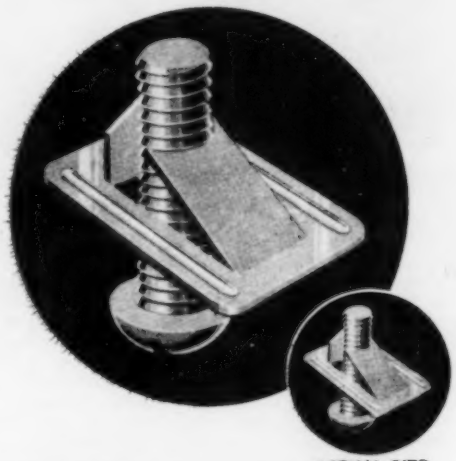


wash and lastly into drying unit. Accurately controlled gas or electrically heated elements are provided in both radiator and double-drum-ironing types of dryers, depending upon model of machine used. Speed of operation is outstanding feature, Model 27 producing from a minimum of 8 in. to a maximum of 13 ft. per minute and Model 27-D from a minimum of 8 in. to a maximum of 14 ft. per minute.—**C. F. Pease Co., 813-821 N. Franklin St., Chicago, Ill.**

STREET LIGHTING LUMINAIRE distributes light evenly along street by reflectors and bi-flectors made of specular Alzak processed aluminum. Consists of canopy, reflector, globe holding ring and globe. Light center of lamp is 1¾ in. above bottom of main reflector, producing sharp cut-off below horizontal. Overall height, 22¾ in.; diameter, 13⅜ in. Reflector spun from thick aluminum has 5½-in. diameter heel large enough to clear maximum size lamp (10,000 lumen or 500 watts). For asymmetric distribution additional bi-flectors are mounted inside of main reflector. Rectilinear globe held to reflector by globe band. Dustproof and weatherproof, easy to re-lamp and maintain.—**Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa.**



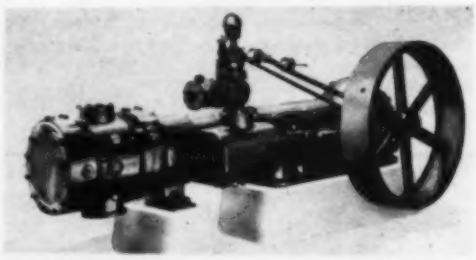
HEAT INDICATING PAINTS for interior and exterior surfaces have property of changing color when exposed to heat and are of particular interest to production and maintenance engineers who wish to detect serious deviation in temperature in processing equipment and power machinery transmissions. Series of five permanent changes and seven retroactive color paints are available. Former change at temperatures ranging from 300 to 734 deg. F.; latter from 122 to 464 deg. F., with safety margin of 25 deg. F. Each temperature change is sharp and wide, leaving no room for doubt as to heat of object to which it is applied. Use of such paint is said to insure against loss of production and loss of time by giving warning to operators through color change. Some colors change to original color when cooled; others remain permanently changed, requiring coating after each use. Retroactive ones good for from 25 to 50 changes. Efkalin paints do not deteriorate in package and will keep for 12 months if properly stored.—**The Efkalin Co., 804 E. 141st St., New York City.**



ACTUAL SIZE

"QUICK-LOK" NUT has patented tongue with forked end which engages thread of bolt. Resulting tension locks tongue, preventing bolt from working loose or coming off. Guide lip is bent at angle of 90 deg. to keep bolt from rocking and tilting when pressure is applied. Made of high carbon spring steel tempered to give required strength to tongue. Reinforced by ribs to give body and tongue additional strength. Easily applied by pushing it on bolt and giving bolt few turns with screwdriver until nut automatically locks itself.—**Philip Carey Co., 410 N. Michigan Ave., Chicago, Ill.**

DRAGLINE BUCKET CHAIN of cast manganese steel has been redesigned and its producers claim for it the following design advantages over older products: (1) increased strength; (2) full-line instead of point bearing between links; (3) additional metal on sides of links where abrasive wear comes; (4) lighter weight; (5) tiebar across link to prevent snarling and kinking; (6) equalized metal sections insuring perfect heat treatment in manufacture and consequent better physical properties; (7) clean lines making for clean castings; (8) distinctive design; (9) made of heat-treated austenitic manganese steel which combines strength, toughness and resistance.—**American Manganese Steel Co., 379 E. 14th St., Chicago Heights, Ill.**



STEAM-DRIVEN COMPRESSOR, heavy-duty, single-cylinder double acting unit for steam pressures 80 to 250 lb., air pressures up to 150 lb., sizes 279 to 1,987 c.f.m. Steam cylinder placed in tandem with air cylinder next to frame and heavily lagged for steam economy. Steam valve of balanced piston type has inlet pressure in middle, and valve rod box is sealed against exhaust pressure only. Controls available: (1) throttling fly-ball governor for steady steam and air pressure; (2) fly-wheel governor for variable steam with steady air pressure. Timken double row main bearings, force feed lubrication, special cast alloy air cylinder liner and valves with laminated cushion backs are other features.—**Sullivan Machinery Co., Michigan City, Ind.**

News from Manufacturers

ABOUT THEIR PRODUCTS

The publications, reviewed below, will keep you posted on latest developments in construction equipment and materials available for your use.

BELT CONVEYORS — **Chain Belt Co.,** Milwaukee, Wis. (114 pp., illustrated, loose-leaf plastic binding). Catalog of equipment and engineering data on design and application of belt conveyors for handling all bulk materials, with full listing and description of belt conveyor equipment. Specifications for completely standardized Rex belt conveyors, with many useful charts and tables for quick and convenient selection of proper unit for any particular requirement. Dimension drawings to aid engineers in incorporating units in material handling plant design. This publication is not merely a catalog in the ordinary sense of that word, but is rather a comprehensive engineering manual of belt conveyor practice. Chapter heading include: Industries served; belt conveyor design; belt conveyor idlers; belt conveyor machinery (trippers, cleaning brushes, shafting, keys, flexible couplings, journal bearings, pillow blocks, take-ups, pulleys and spur gears); notes on ordering.

• • •

CRAWLER EXCAVATORS—**Link-Belt Co.,** 300 W. Pershing Road, Chicago, Ill. (12 pp., illustrated). **Speed-o-Matic** hydraulic power control of shovels, cranes and draglines reduces operator fatigue and increases yardage.

• • •

MOTOR-DRIVEN WELDERS — **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa. (8 pp., illustrated). Application, construction, specifications and performance curves for single operator 200-, 300-, and 400-amp. Flexarc motor-driven welders and bare generators. Single-dial, pre-set current control.

• • •

STEEL SHEET PILING—**Steel Union-Sheet Piling, Inc.,** 75 West St., New York, N. Y. (32 pp., illustrated.) Larssen deep-arch sections of steel sheetpiling for docks, piers, seawalls, beach protection works, jetties, cofferdams, bridge pier foundations, core-walls, and retaining walls. Sizes range from 9.6 to 64 lb. per square foot of wall and are furnished in 21 sections. Tight dovetailed interlock in wall axis reinforces pile flanges and minimizes seepage of water. Copper-bearing steel to resist corrosion in salt water. Tabulated data on dimensions and properties of standard sections and union box sections. Working details sketched for corners, branch piles, anchorage and capping. Designs for ocean groins and cofferdams. Detailed information concerning driving of piling available in pamphlet form.

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ARC WELDING — **Harnischfeger Corp.,** Milwaukee, Wis. (18 pp., illustrated.) Cites advantages of internally stabilized arc and single current control offered in Hansen Smooth arc welders. Furnished in both horizontal (200- to 600-amp. capacities) and vertical (75- and 100-amp. capacities) types. Made in stationary and portable trailer models. Cutaway view shows design of welder. Explanatory notes on arc characteristics.

• • •

STEEL PIPE, TANKS, BUILDINGS — **Pittsburgh-Des Moines Steel Co.,** Pittsburgh, Pa. (12 pp., illustrated.) Illustrations of application of company's products for pipe lines, elevated tanks, water works, irrigation, penstocks, swimming pools, refuse incinerators, sewage works, bridges and industrial buildings.

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DIESEL TRACTOR — **Caterpillar Tractor Co.,** Peoria, Ill. (32 pp., illustrated). Complete information and specifications on RD7 tractor, with action pictures illustrating wide range of applications. Weight, 20,980; gages 74 and 60 in.; bore and stroke 5¾x8 in.; 850 r.p.m. Diagrams, in two colors, explain fuel system, fuel injection valve and pump, governor fuel filters, valve mechanism and fuel pressure lubrication. Details of transmission, direct final drive and track assembly. Full floating equalizer spring.

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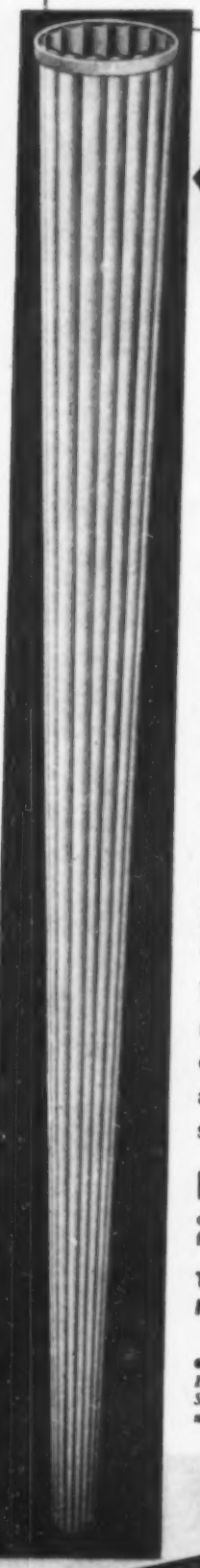

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News from Manufacturers

ABOUT THEIR PRODUCTS

(Continued)

PRESSURE DISTRIBUTOR — **Littleford Bros.,** 443 East Pearl St., Cincinnati, Ohio. (16 pp., illustrated.) Model C machine, with capacities of 500 to 2,000 gal., handles tar, asphalt, road oil, cutback or emulsion at rates of from 1/10 to 2½ gal. per square yard, with any length spray bar up to 24 ft. Single valve control cuts off spray at nozzles instantly, and sucks back material in lines into tank. Low pressure burner consumes inexpensive fuel oil. Improved heat chamber thaws out pump, valve, manifold bar and by-pass line. Accurate tachometer controls rate of application. Hand spray attachment with quick acting couplings. Tank insulated with 1-in. rock wool blanket. Detailed specifications. Truck or semi-trailer mounting.

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WOOD FIBRE BOARD — **The Insulite Co.,** Minneapolis, Minn. (6-pp. folder, illustrated). Hints on design, application and treatment of Insulite interior finish products for walls and ceilings of buildings, including plank, tile, building board and hardboard. Two colors, light and gray-brown; two surface textures, burlap and linen. Series of additional folders illustrates possible effects offered by interior finish products in buildings of various types, including churches, stores and restaurants.

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DYNAMITE — **Institute of Makers of Explosives,** 103 Park Ave., New York, N. Y. (11 pp.). Information on characteristics of dynamite and the purposes for which it can be used. Statistics on mine and quarry production and quantities of explosives used.

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VERTICAL COMPRESSORS — **Worthington Pump & Machinery Corp.,** Harrison, N. J. (8 pp., illustrated.) Compact presentation of the Worthington line of vertical single-cylinder single-stage air-cooled and water-cooled compressors. Sectional views show important features of construction. Detailed specifications of leather-type valves and other principal elements. Rating tables and dimension tables are included. Bare compressors and base-mounted units with motor and V-belt drive are covered in tables. Illustrations show also units complete with vertical or horizontal air receiver, direct-connected to electric motor, direct-connected to gasoline engine, and three-cylinder and six-cylinder angle-type two-stage units in various arrangements.

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BUCKETS — **George Haiss Manufacturing Co.,** 141st St. and Canal Place, New York, N. Y. (Two 4-page bulletins, illustrated.) Buckets of clamshell type for excavating and for rehandling materials. Sizes range from ⅜- to 1½-yd., for excavating, and from 1/3- to 3-yd. for rehandling buckets. Tables of weights, capacities and dimensions. Descriptive notes on mechanical features cover bowl design and closing mechanism.

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WELDING STAINLESS STEEL—**Republic Steel Corp.,** Cleveland, Ohio. (20 pp., illustrated). Describes in detail the proper methods for welding Enduro stainless steel by electric arc, gas, seam, spot, projection and atomic hydrogen methods. Also included is information on brazing and silver soldering. A table shows in condensed form the physical, electrical and mechanical properties of thirteen of the more important types of Enduro stainless steel, contrasted with similar properties of a carbon steel.

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ROAD CONSTRUCTION EQUIPMENT — **Caterpillar Tractor Co.,** Peoria, Ill. (20 pp., illustrated.) Pictorial presentation of application of tractor-operated equipment to road-building operations, including clearing with bulldozers and stump-pulling, roughing in side-hill roads with angledozers, finishing bank sloping and ditching with blade graders, handling cut and fill, earth haulage in wagons, rolling and tamping fill, elevating grader work maintenance with auto-patrol machines and bituminous road-mix.

EARTH-MOVING METHODS—**Cleveland Tractor Co.,** Cleveland, Ohio. (80 pp., illustrated.) Performance of gasoline and diesel Cletrac tractors, with auxiliary equipment, based on time studies and engineers' and contractors' data covering a wide range of specific jobs. Among the chapter headings are: Factors that influence earth-moving estimates; fresnos; bulldozers; self-loading wheelers; carry scrapers; crawler wagons; elevating graders; large pneumatic-tired wagons; sheepsfoot tampers; rippers. Tabulated figures give breakdown of cost of operating tractors. There is a page of handy formulas on short cuts in estimating and data on wagon draft requirements. Book is profusely illustrated to show applications of tractor-operated equipment on the job. Useful figures on yardage and unit costs of earth handled per hour by various combinations of equipment. The data, assembled by D. A. Milligan, the company's equipment sales engineer, should be helpful to contractors in selecting proper equipment for a job and preparing estimates of cost of earth moving.

• • •

HINTS ON PILE DRIVING — **Steel Union-Sheet Piling, Inc.,** 75 West St., New York, N. Y. (22 pp., illustrated.) Practical advice on methods and equipment for driving Larssen and Union steel piling, preferably with heavy automatic double-acting hammers. Recommendations on weight of hammer. Discussion of driving conditions, alignment of hammer, interlocking piles in pairs, guiding piles, staging for driving in water or soft ground, driving caps and methods of driving. How to prevent piles from "leaning forward." Water jetting. Taper piles.

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SCREW AND BOLT ANCHORS — **Rawlplug Co., Inc.,** 98 Lafayette St., New York, N. Y. (32 pp., 3½x6¼ in., illustrated). For screw anchorage, cylindrical plug of jute fibre in drilled hole receives screw which, as it enters, expands jute fibres, compressing them against side of the bore to insure tight fit. For bolt anchorage in drilled hole, cylinder of lead with double cones of zinc is expanded by hammer blow on calking tool, causing cones to come together and force lead to fill hole. Also described and illustrated is a one-piece expansion bolt for use in masonry surfaces.

• • •

CONCRETE BY PIPE LINE — **Chain Belt Co.,** Milwaukee, Wis. (51 pp., illustrated, loose-leaf binding.) Mechanism and application of Rex Pumpcrete units on variety of jobs, both large and small. New, small size machine, mounted on pneumatic tires for towing from job to job, has capacity of 15-20 cu.yd. per hour through 6-in. pipe line 800 ft. long, horizontally, or 100 ft., vertically. Larger machines (single and double in capacities up to 50-65 cu.yd. per hour. Section on "What Rex Pumpcrete is Doing," comprising 26 pages, is pictorial presentation, with descriptive notes, of delivery of concrete by pipe line on wide range of projects, including bridges and viaducts, dams, tunnels, waterworks, sewage plants, foundations, aqueducts, buildings and canals. Detailed description covers concrete mixes and their effect on pumpability, mechanics of method and distribution of concrete at end of pipe line. Specifications and useful tabulated data on how fast and how far concrete can be pumped. To date a total of 4,000,000 cu.yd. of concrete has been placed by pump and pipe-line method.

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INDUSTRIAL AIR FILTERS — **Air-Maze Corp.,** 812 Huron Ave., Cleveland, Ohio (6 pp., illustrated). Oil bath, Multimaze and panel types of air filter for all fields of application, including diesel, gas and gasoline engines, air compressors, generators, pumping units, blowers and air conditioning systems. Information on how to determine size of air filter required.

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FOR NON-SHRIKING MORTAR — **Truscon Laboratories,** Detroit, Mich. (4-pp. folder, illustrated). Describes "Mortite", a product containing a water-repellent compound which is added directly to the mortar mix to lower the water ratio and prevent shrinkage cracks with corresponding loss of bond, structural strength and waterproofness.

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WINCHES, DERRICKS, CRANES — **Gar Wood Industries, Inc.,** Detroit, Mich. (16 pp., illustrated.) Jaw clutch winches with pulls of 10,000 to 20,000 lb. for mounting on trucks. Friction drum and keyed drum winches in single- and double-drum models. Vertical and horizontal capstans. Pole derricks of seamless steel tubing for attachment to rear ends of motor trucks; notes and diagrams on installation and use. Sheave blocks. Truck-mounted cranes for tree moving, pipe laying and wrecking.

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Faster streamlined mixers!

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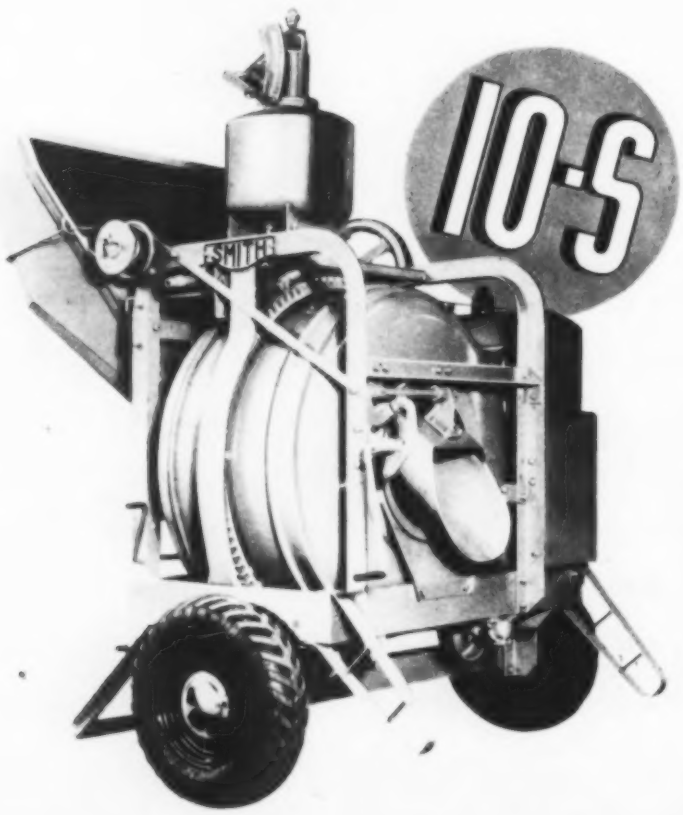
These new Smith Mixers are the "Tops". Modern in appearance—modern in design—modern in performance. So easy to move, yet husky brutes, able to take hard everyday punishment for years. Try a Smith on your next job. You'll appreciate its speed — thorough mix and, above all, PROFIT EARNING ability.



TRAIL-SMITH

Compact, lightweight trailer mixer. Tows behind car or truck at fast driving speed. Equipped with spring-mounted axle and new roller bearing automobile type wheels with oversize low pressure pneumatic tires. Automatic skip vibrator. Enclosed gear reduction. Multiple V-belt drive. Vertical- syphon-type water tank. Roller bearings throughout.

MOVE IT FAST — MOVE IT OFTEN

●

All sizes of mixers available.
Write today for literature.

THE T. L. SMITH COMPANY
2851 North 32nd Street **Milwaukee, Wisconsin**

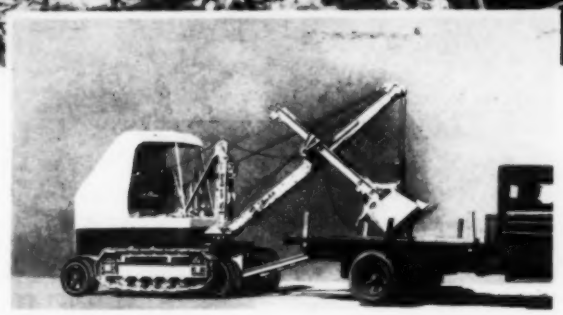
SMITH MIXERS

THE BOULDER DAM MIXERS

You Can't Beat it ... for

DIGGING BASEMENTS

BYERS BEAR CAT JR.



Here is the average daily cost of Bear Cat Jr. operation, according to 150 owners:

9 Gallons Gasoline per 8 Hr. day at 14c per gal.	$1.26 per day
Oil change every 6 days	.13 per day
Grease	.10 per day
Depreciation (5 year period)	5.32 per day
Interest on investment 6% (5 years)	1.60 per day
Repairs, Figuring 200 wk. days per year	1.33 per day
Total Daily Operating Cost (not including operator)	9.74 per day

With a Bear Cat Junior, you'll dig an ordinary basement in four or five hours and you may be sure you are digging it at rock bottom costs. . . . Then, when the job is done, the Bear Cat Jr. 2-axle trailer easily and quickly hauls the shovel to your next job . . . No other shovel digs so economically, no other shovel is moved so easily. Don't try to beat the Bear Cat Jr. for low cost basement digging . . . Get the 28-page illustrated booklet "Bear Cat Jr. Facts" for the whole story about this big money making ⅜ yard, ¾ swing shovel that weighs only 15,000 pounds.

BYERS BEARCAT JR.

THE SHOVEL THAT IS ALWAYS BUSY

When RESULTS *are Needed* — *Specify*— INTERNATIONAL POWER

Six International TracTracTors were used in the construction of the new $3,000,000 Portland, Ore., airport. This shows one of the two Diesel-powered TracTracTors pulling a 6-yard carry scraper. The four other units were gasoline-powered and did the bulldozing. Some 4,600,000 yards were dredge fill and an additional 2,000,000 yards were moved by these Internationals in leveling operations.

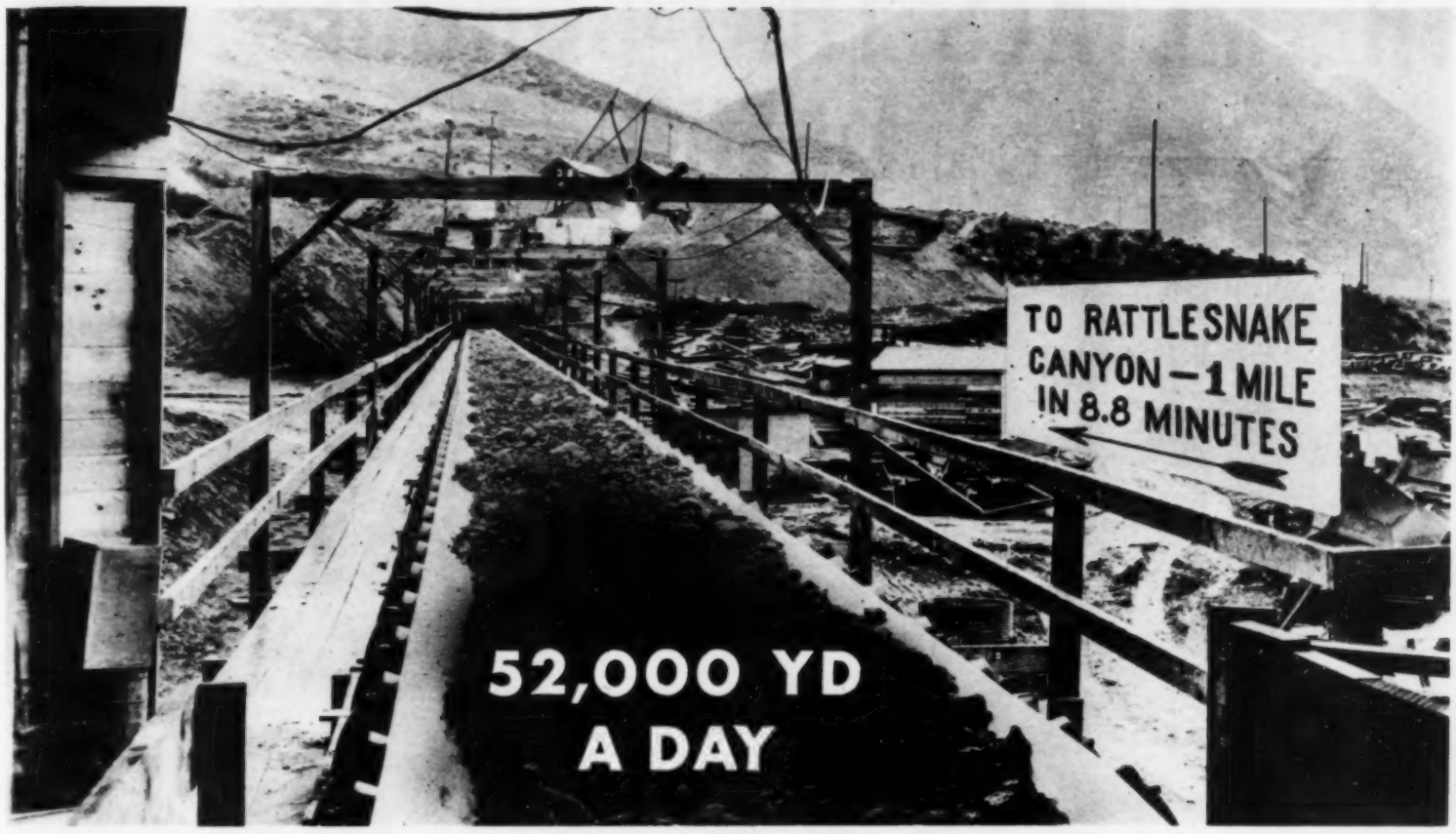
An International PD-80 six-cylinder Diesel Power Unit at work on a big crusher plant near Maupin, Ore.

LET this sound advice from *experienced* users direct your purchases of industrial tractors and power units. Cash in on the advantages INTERNATIONAL *Performance* and INTERNATIONAL *Economy* bring to the job—advantages that make you feel mighty good when the cost sheets are figured.

International Industrial Power has a reputation for getting things done fast . . . that's why you find the *big* jobs being turned over to International. And when service is needed, the low maintenance cost of each unit in the International line means amazing savings. Wheel and crawler tractors (gasoline and Diesel) for mobile power, and power units (gasoline and Diesel) ranging up to 110 max. h. p. for stationary work are available. See the nearby International industrial dealer or Company-owned branch for complete information.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
606 So. Michigan Ave. Chicago, Illinois

INTERNATIONAL Industrial Power



Moving a Mountainside on a Modern Magic Carpet

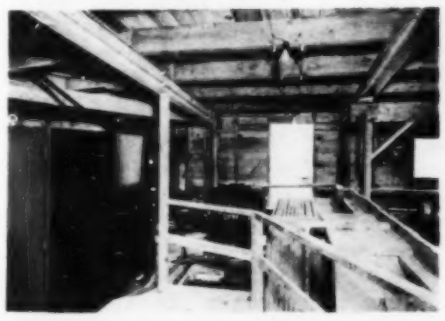
GETTING down to granite for the foundation support of Grand Coulee Dam required the excavation of 13,000,000 cubic yards, and, for carrying this spoil, a continuous conveyor system more than a mile long, leading up into a distant canyon, was called for.

To handle this record job, the contractors, the Mason-Walsh-Atkinson-Kier Company, and the Jeffrey Manufacturing Company planned the largest and swiftest belt-conveyor system ever built.

Equipped with a General Electric drive and control system, the success of this conveyor was immediate and continuous. It carried 52,000 cubic yards a day.

Twenty-five 200-hp G-E motors operated the individual conveyor sections, which ranged from 200 to 275 feet in length. Other G-E motors operated the stacker, a shuttle conveyor, and feeders. G-E control placed operation of the entire system at the finger tips of the operator in the control house on the stacker. Operation of the entire conveyor system was electrically interlocked so that a stoppage of any one section automatically stopped all other sections on the incoming side.

The contractors estimate that they saved 60 per cent on the cost of moving spoil by using the electrically equipped, automatically controlled conveyor system.



One of 25 G-E 200-hp motors and part of G-E control operating conveyor system at Grand Coulee Dam

TO GET SPEED FOR THE JOB, COMPLETE SERVICE FOR YOUR MONEY, SPECIFY "GENERAL ELECTRIC"

While there are few projects comparable in magnitude to Grand Coulee Dam, there are many in which new and properly applied General Electric equipment can help contractors save money.

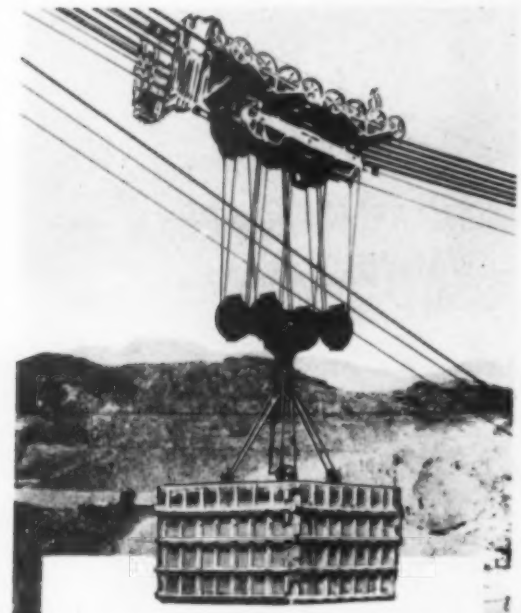
Consult the General Electric sales office in your territory, or write General Electric, Schenectady, N. Y.

011-166 A

GENERAL ELECTRIC

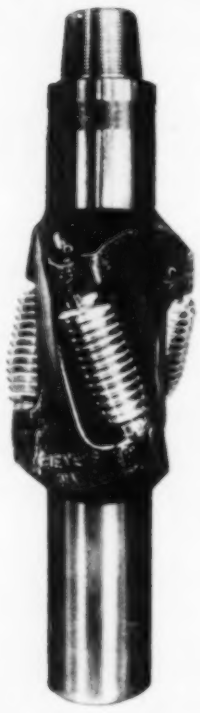
THE METALS THAT CONQUER NATURE...

are needed in EVERY plant!



● Here is the cableway that was used for lowering materials down to the bed of Boulder Dam. Nickel Alloy Steels helped to make it the strongest ever built. ...150 tons capacity. When weight must be held down, the ordinary steels have limitations. Here's where the Nickel Alloy Steels come in. Their high strength-weight ratio accompanied by unusual toughness makes it possible to construct machinery for the heaviest duty without increasing the weight of vital parts.

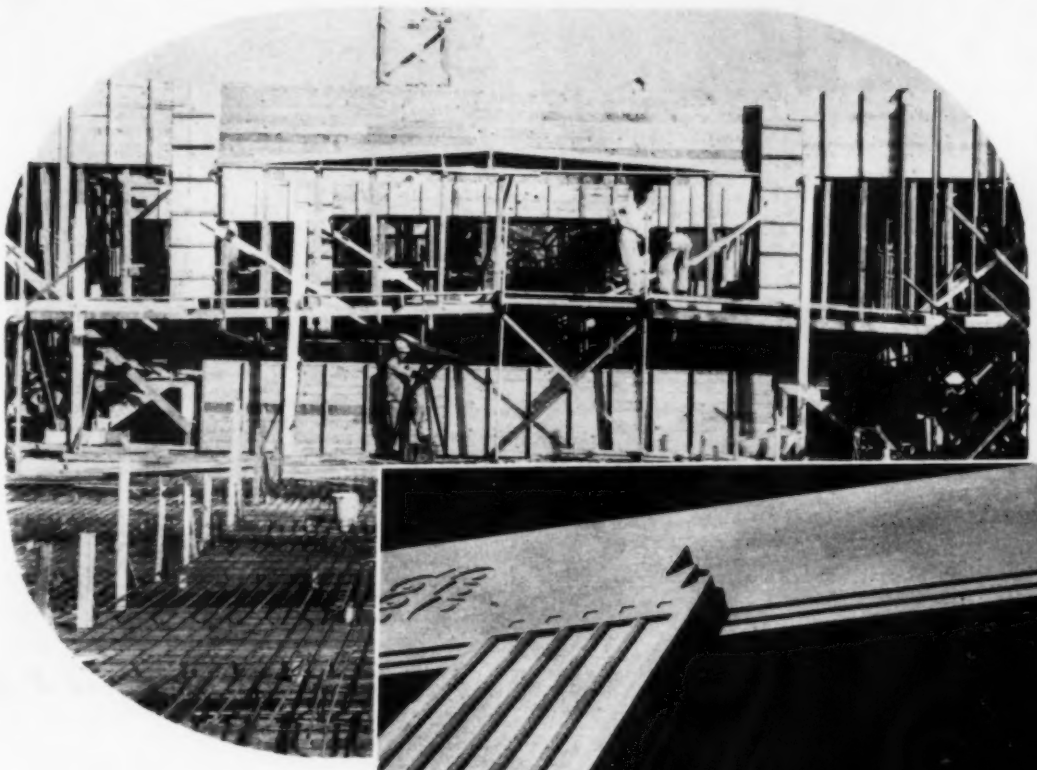
● Power shovels must take everything that comes their way. No machinery fights a more bruising battle, takes more shocks, stresses, wear. If you are using or building equipment that requires stamina to spare, take a tip from the makers of excavators. Their standard practice is to make liberal use of Nickel Steels and Nickel Irons for parts that get the hardest usage. Because of their high resistance to stresses and wear, replacements are seldom necessary.



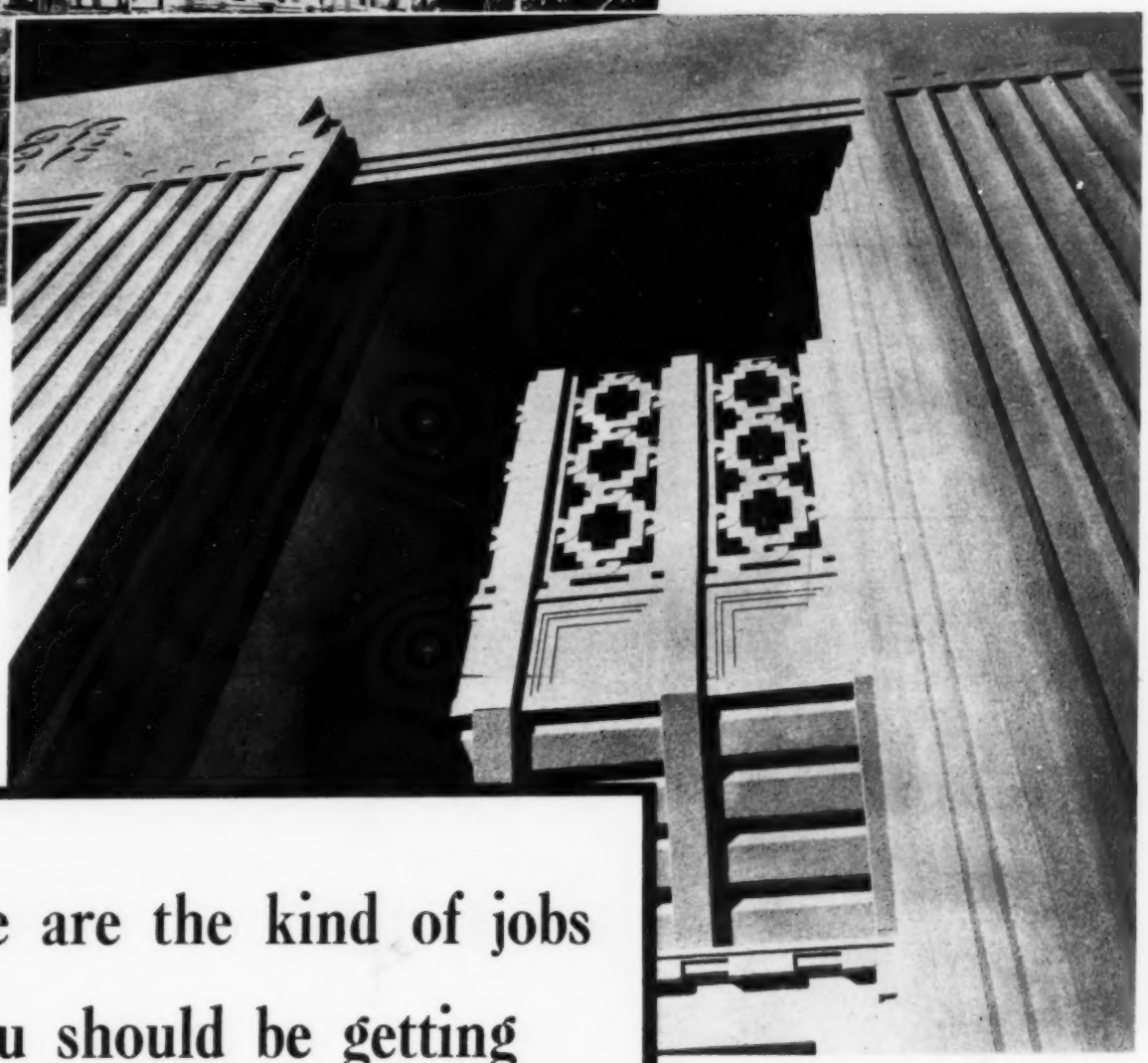
● This reamer helped to dig one of the deepest oil wells ever drilled — more than two miles deep. Picture it grinding through rock, shale, earth and sand! Heavy abrasion all the way, and heavy shocks too. But they mean little to this husky tool because it is made of wear-resisting, shock-defying Nickel Alloy Steel. Perhaps you have a gear or a shafting problem that has always been troublesome. Here's your answer, no matter what the job. The long-run economy of the Nickel Alloys Steels and other alloys containing Nickel can be quickly demonstrated. Our engineers will be glad to advise you concerning applications and compositions best suited to your requirements.

NICKEL ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.



Construction view of Southwest Junior High School, San Antonio, Texas. Walls and floors are of reinforced concrete; plywood forms. Architects: Phelps & DeWees, and Leo M. Dielman. Engineers: J. W. Baretta, Inc. Contractor: Ed. F. Oeffinger, San Antonio.



Northwest Junior High School, San Antonio, Texas, shows well the possibilities of concrete as a combined architectural and structural medium. Walls: monolithic with frame and floors. Grilles: precast concrete. Finish: buff stucco dash coat. Phelps & DeWees, Atlee B. and Robert M. Ayres, and Adams & Adams, architects. Matthews & Keenan, engineers. King B. Key, contractor.

These are the kind of jobs you should be getting

These two Texas high schools typify the modern trend toward architectural concrete construction. They're the kind of jobs that will bring new business to the firms that did them.

Perhaps in your locality, buildings of all kinds are being designed for concrete. YOU can build them — if you're familiar with the latest technique in making dense, uniform, water-resistant concrete and if you know how to build forms that not only hold the concrete while it hardens, but mold it into the desired architectural shapes.

Let us help by sending free copies of the manual, *"Forms for Architectural Concrete"* and *"Concrete Guide — with tables of Quantities of Materials."*

Architectural Concrete
WALLS, ORNAMENT, FRAME AND FLOORS INTEGRALLY CAST

PORTLAND CEMENT ASSOCIATION
Dept. 6-16, 33 West Grand Ave., Chicago, Ill.

This microscope

checks the structure of the wire used in Macwhyte Wire Rope

Notice how the structure of wire changes during Macwhyte's cold drawing process. The upper photograph shows its structure before drawing—the lower photograph shows it after drawing. The lengthening and interlocking of steel fibres practically doubles the strength of Macwhyte wire and greatly increases its resistance to fatigue.

● Every coil of wire used in Macwhyte Wire Rope—both PREformed and non-preformed—must be checked in the Testing Department before it is released to the Rope Mill. A metallurgist here examines the structure of the wire through a powerful microscope.

Other tests are also made to determine tensile strength and toughness. Unless wire measures up to the highest standards it is rejected. As in the Macwhyte Wire Mill, every operation in the Laboratory is under the supervision of specialists. High tonnage is never gained at the expense of quality. This strict policy, plus constant testing to assure uniformity, lies behind the remarkable service given by Macwhyte PREformed Wire Rope.

Monarch WHYTE STRAND PREformed Wire Rope is specially designed for jobs where ropes must stand up under severe bending. Macwhyte manufactures special constructions for shovels, draglines, cableway excavators, scrapers, loaders, mixers, pavers, incline hoists. Macwhyte also makes specially designed non-preformed ropes.

MACWHYTE
PRE *formed*
WIRE ROPE
INTERNALLY LUBRICATED

NO. 501-C

MACWHYTE COMPANY, Kenosha, Wisconsin • Manufacturers of wire rope and braided wire rope slings. Distributors and stock throughout the U. S. A. for quick service.

IN THE SPOTLIGHT *of Activity*

IN a majority of cases where projects are going ahead you'll find Owen Buckets in the "thick of the fray"—dredging piers — excavating foundations — handling material.

This is not an idle statement, but a fact to be substantiated by checking the newly issued list of successful contractors who handled the larger projects during the past year.

This teaming up of successful contractor and successful bucket is not a mere coincidence. Selection of the Owen Bucket doubtless reflects the demand of these contractors for reliable facts and their keenness of judgment, which in themselves, are strong endorsements of these buckets.

The New Catalog, just off the press, describes and illustrates several features which make Owen Buckets even more efficient. You'll be interested also in the Owen Rock Grapple of entirely new and original design. Drop a line NOW for your copy.

THE OWEN BUCKET COMPANY

6020 BREAKWATER AVENUE **CLEVELAND, OHIO**

BRANCHES · NEW YORK · PHILADELPHIA · CHICAGO · BERKELEY, CALIFORNIA

Killefer road equipment

- Revolving Scrapers
- Revolving Rippers
- Regular Rippers
- Road Discs, or Planers
- Compacting Harrows
- Oil-Mix Cultivators
- Ditchers
- Mole-Drain Machines

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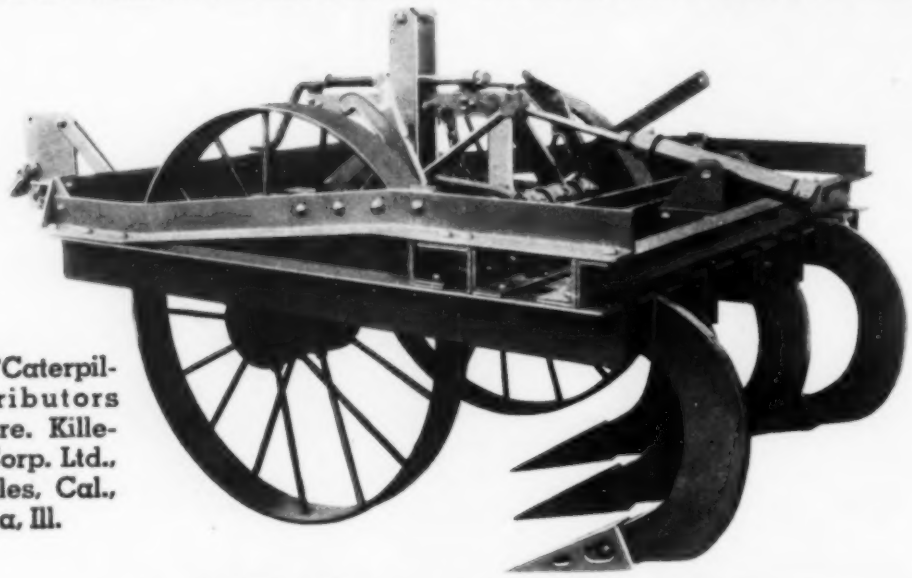
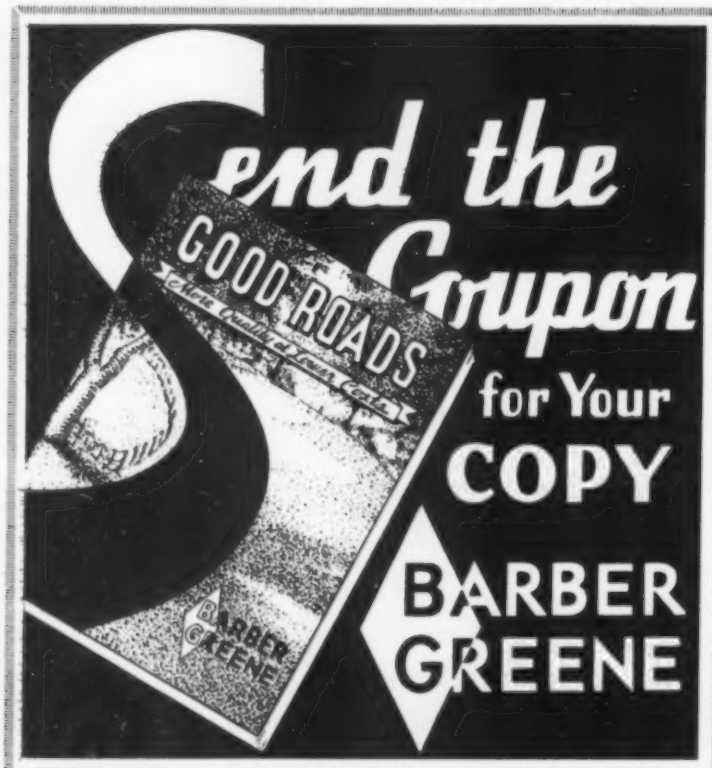
Write for Literature

A HEAVY time-tried ground breaker for tractors of 40 to 60 H.P. Wt. 4180 lbs. Heat-treated standards and points (spacing 12", depth 12"). Leaves the ground well broken for the fills and ideal for full scraper loads, etc. Self-contained lift. Hot riveted frame construction. Has excellent penetration and underframe clearance. A standard tool all over the world. Two smaller models. Write for folder 22 DA.



Sold by "Caterpillar" Distributors everywhere. Killefer Mfg. Corp. Ltd., Los Angeles, Cal., Peoria, Ill.

10B Road Ripper



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Please send me your new 52-page booklet, "Good Roads", which shows the entire Barber-Greene line of equipment for contractors.

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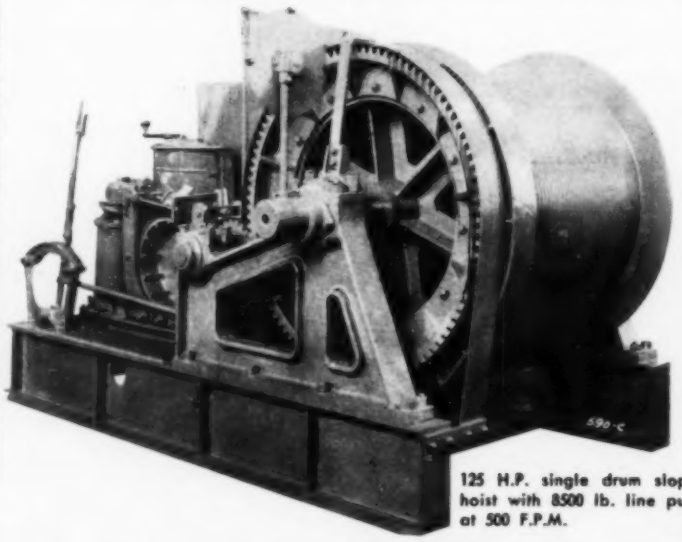
Clyde hoists for all work . . .

Contractors, builders, industrial plant owners, material handling men . . . all find Clydes a profit sharing investment of many years duration. Quality equipment for every kind of work . . . for every size job. Standard machines shipped immediately from stock or special units designed to fit your own particular needs.

Write for a bulletin on steam, electric, gasoline or belt hoists . . . carpullers . . . dredge and dock equipment . . . timber and steel derricks . . . whirleys.



125 H.P. single drum slope hoist with 8500 lb. line pull at 500 F.P.M.

CLYDE IRON WORKS, Inc.
Duluth, Minn.

Widths Varied to 44 ft., Sections 9 to 11 ft. Thickness 1½" to 10"—One Jaeger Laid All!

HERE'S THE WAY JAEGERS PAY

"Work consisted of 9,000 tons plant mixed asphaltic concrete with thickness varying from 1½" to 10" and widths varying up to 44 ft., a large proportion being on superelevated curves. Leveling course was laid in several layers from ¼" to 3" in depth. Jaeger Paver proved especially efficient spreading fine mix (¼" minus) over slight depressions in base course. *Joint blender and easy width adjustments proved of constant value as material was spread over sections varying from 9 ft. to 11 ft.*" WOODWORTH & CORNELL, Inc., Tacoma, Wash.

Like Woodworth & Cornell, when paving South Tacoma Way, road builders who have faced difficult conditions know that the Jaeger Paver is the one machine sufficiently adaptable to meet their problems. They know, too, that on any job their Jaeger Pavers have produced for them a high daily tonnage, smoothness of surface, and savings on hand work never before possible.

No matter how fast the pace or steep the grade, Jaeger's 4 semi-crawlers never touch the new material, always have speed and traction to spare. No matter how sticky the mix, Jaeger's re-mix pug mill spreader passes it easily and quickly thru the machine.

No matter how rigid the inspection, Jaeger's 19½ ft. floating straight edge runners, which carry screed and blenders and average out irregularities in subgrade, insure a smooth and excellent riding road. Jaeger's blenders complete perfect joints, make it easy to lay flush to curb or concrete slab.

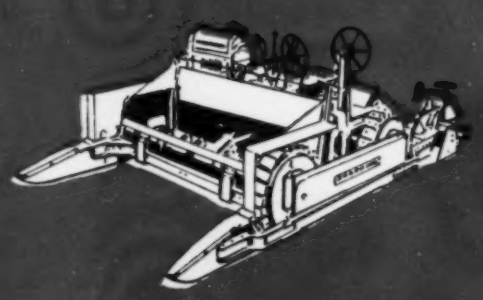
Heated screeds, oscillating blenders now available

Write today for new Catalog PM-37 describing latest improvements in machines and methods for laying bituminous — information important to every road builder.

JAEGER MACHINE COMPANY

800 Dublin Ave. Columbus, Ohio

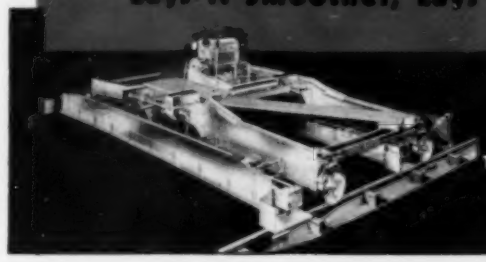
JAEGER *Bituminous* PAVER



Adjustable for Widths to 14 Ft.

No Weight, No Traction on New Road

Lays It Smoother, Lays It Faster



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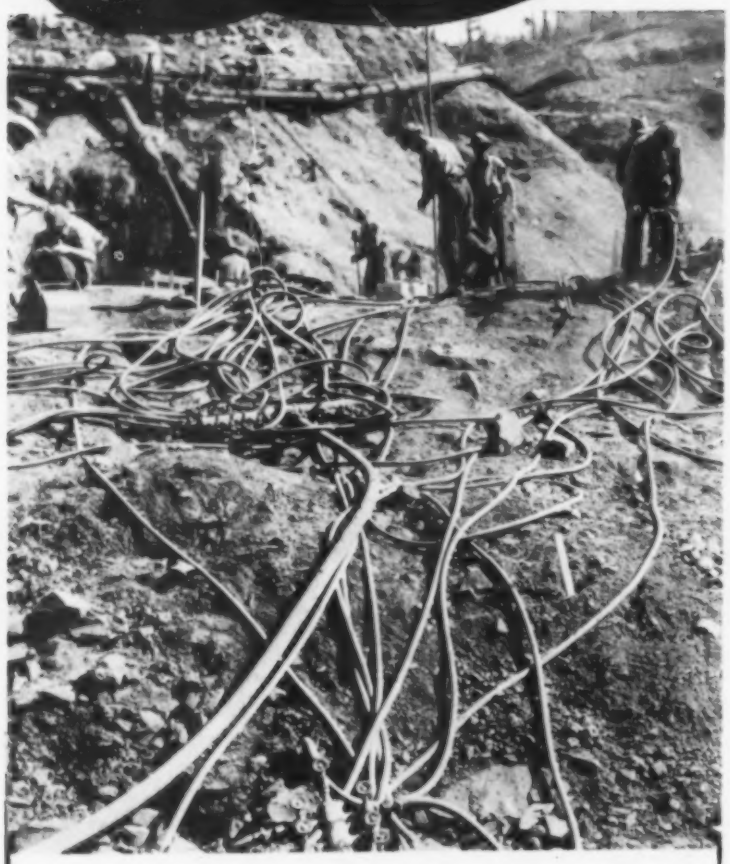
SPEED KING 10S Bridge Builder Mixers --Other Non-Tilts, Tilters, 3½S to 56S Sizes

SURE PRIME Contractors' Pumps--2" to 10" Sizes, 7,000 to 200,000 G.P.H

DRILLS
equipped with
"SUBWAY"
never take "time out"



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Once this dependable hose is installed, breakdown troubles . . . and costs . . . are ended. That's why contractor's everywhere are specifying "SUBWAY — That Red Air Hose of Goodall's." Its ability to *take it*, inside and out, is the result of 32 years of GOODALL specialization.

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The QUICK-WAY
is FIRST on the job...
FIRST to finish up!

Speed! roadspeed -- operating speed! That's one reason for Quick-Way's outstanding success ... one reason why the Quick-Way Truck Shovel is the choice of the engineers and contractors who demand the best!

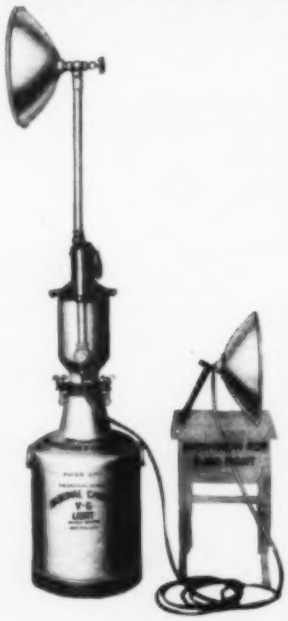
Because the total maximum road load never exceeds 11 tons, a Quick-Way will go anywhere just as fast as a 3 to 5-ton truck will carry a 5½-ton load. With 7½ swings a minute, drum speeds as fast as capacity digging permits and definite, hydraulic-control it produces yardage far in excess of its 4/10ths rating. On short moves from 100 yards to a mile—the pull-outs for "shots" in hard rock — the continuous moves in ditch digging — that's where a Quick-Way proves itself!

The Quick-Way Truck Shovel Co.
DENVER, COLORADO

3

The QUICK-WAY there - The QUICK-WAY to do the job - The QUICK-WAY to the next one!

NATIONAL CARBIDE
V-G LIGHTS



National Carbide V.G. Light. 8,000 Candle Power without extension; 16,000 Candle Power using extension. Easily handled by one man.

MORE LIGHT
FOR
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Y 199 National Carbide V. G Handy Light 1500 Candle Power Weighs only 37 pounds charged.

Easily Handled
No Wires
No Carbide
Wasted
No harm done if tipped over

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New! Amazing! Double Efficiency!

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FOR TRACTOR ROLLS . . . CUTS UPKEEP EXPENSE

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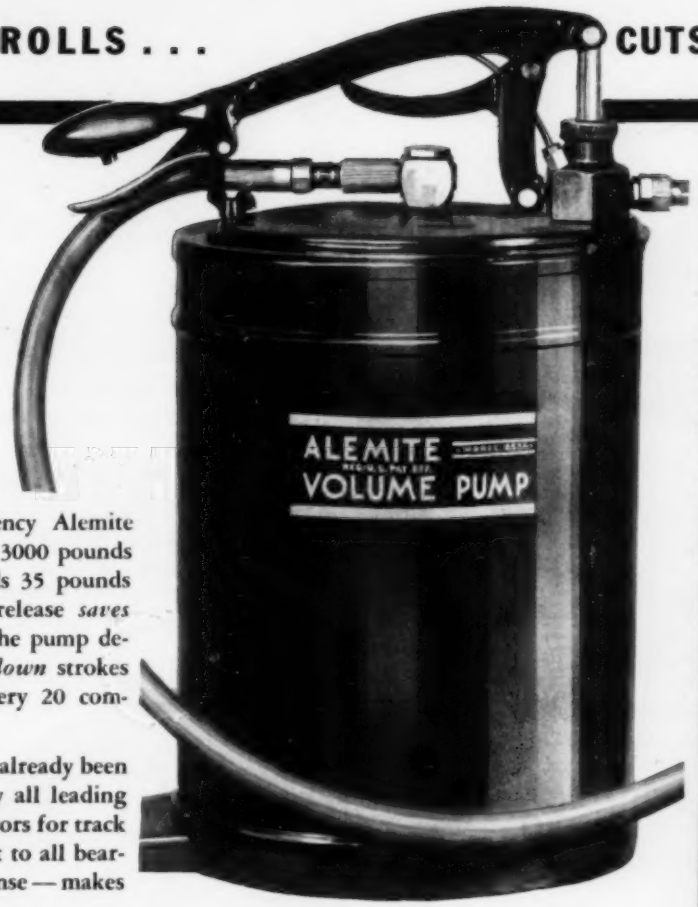
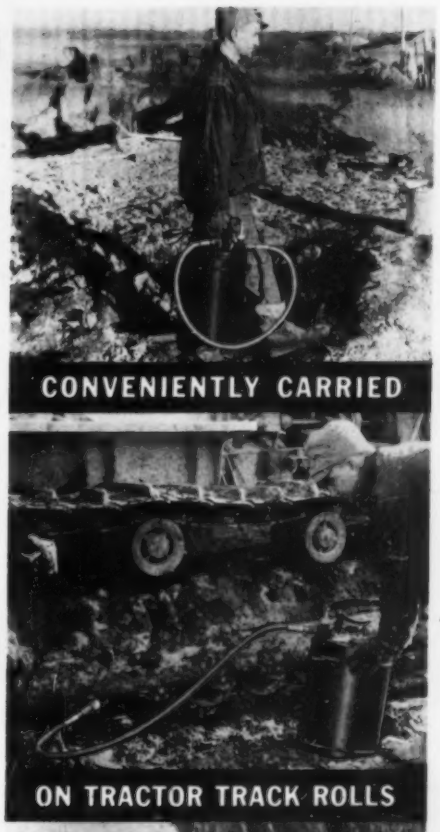
- ★DOUBLE ACTION PUMP

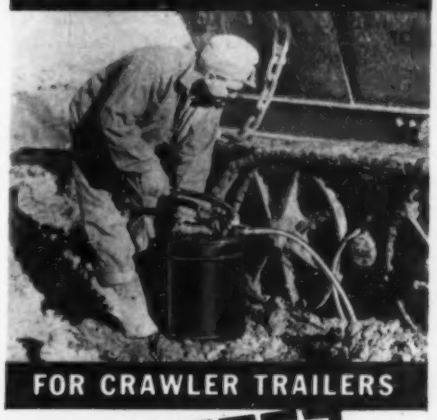


THIS new double efficiency Alemite Volume Pump develops 3000 pounds pressure per square inch. It holds 35 pounds of lubricant. Patented pressure release *saves wear and tear* on the hose. And the pump delivers lubricant on *both up and down* strokes —one pound of lubricant to every 20 complete strokes.

This Alemite Volume Pump has already been adopted as *standard equipment* by all leading manufacturers of crawler-type tractors for track roll lubrication. It forces lubricant to all bearing surfaces—cuts upkeep expense—makes bearings last longer!

Use the new Alemite Volume Pump, with genuine Alemite Lubricants, to give your machines the kind of lubrication the manufacturers *intended* them to have!





● *See how easily this great new Alemite Volume Pump grips the Alemite Giant Button Head Fitting, cleaning off all dirt and forming a leakproof seal.*

You will find complete information on all types of Alemite Guns and Lubrication Equipment in our new FREE manual, "Alemite Controlled Lubrication." Mail the coupon for your copy now!

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WORLD'S LARGEST MANUFACTURERS OF LUBRICATING PRODUCTS

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NO TIME LOST

IN THE TURNING OF NUTS

IF YOU USE THE

FAVORITE

REVERSIBLE RATCHET

WRENCH

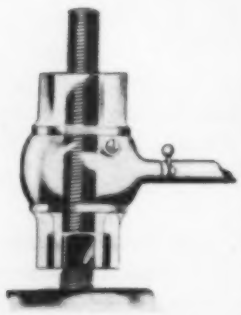
EACH HEAD CAN TURN TWO DIFFERENT-SIZED NUTS

This is a great saving over ratchet wrenches that turn only one nut in each head, as it means fewer parts to keep on hand.

EVERY HEAD IS DOUBLE-ENDED.

Each handle takes five different-sized heads.

Socket form of head fits securely over nut.



WORKS ON A QUICK STRAIGHT-AHEAD RATCHET MOVEMENT

The metal used in Handles, Heads and Pawls enables the "Favorite" to stand up under harder and rougher usage. Ratchet movement eliminates all lost motion. Does not leave the nut until operation is completed.

A TIME SAVER

Can be used in narrower places than an ordinary wrench. Each head can turn two different-sized nuts—one in each end. Opening in head allows bolt to pass clear through.

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POWER-ARM DESIGN GIVES GREATER POWER

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WILLIAMS *Buckets*

POWER-ARM, POWER-WHEEL MULTIPLE-ROPE, DRAGLINE

INSURE AGAINST FALLS *with*

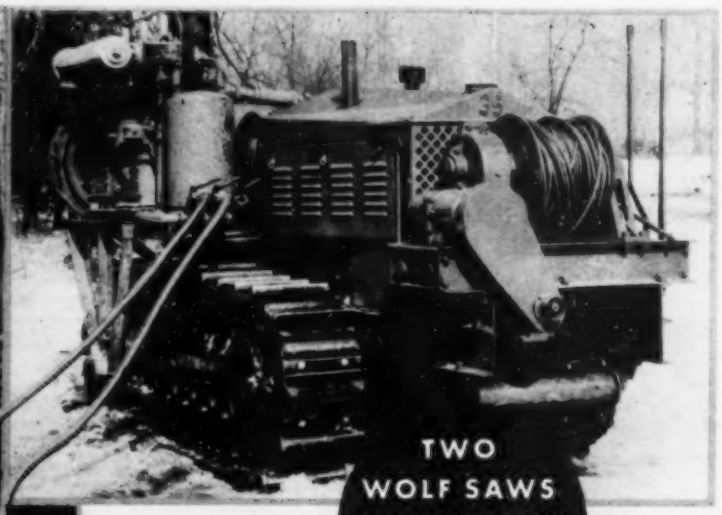
M·S·A SAFETY BELTS

The use of an M. S. A. Safety Belt to prevent falling is infinitely better business than paying compensation *after* a serious tumble occurs! These belts are light and comfortable to wear—do not hinder free bodily movement, and far surpass in strength the most arduous service requirements. In the event of a slip or collapse, belt grips wearer around the chest—not up under arms—holds him in an upright position and enables him to be lifted through narrow openings. ● Two types: linen parachute webbing or selected harness leather, rigidly tested. Write for details and demonstration.

MINE SAFETY APPLIANCES COMPANY

BRADDOCK, THOMAS & MEADE STREETS PITTSBURGH, PA

District Representatives in Principal Cities



TWO WOLF SAWS OPERATED BY ONE COMPRESSOR

U.S. DECLARES WAR

ON DUTCH ELM DISEASE

U. S. DEPT. OF AGRICULTURE TAKES OFFENSIVE • • USES

"WOLF" PORTABLE TIMBER SAWS

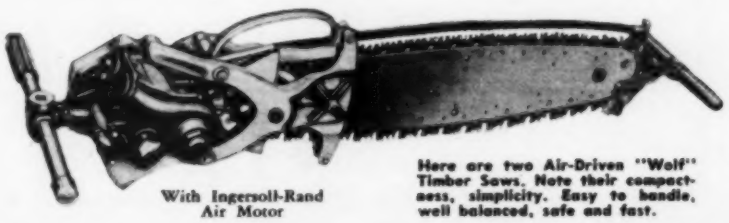
Wolf Portable Timber Saws are being used by

General Contractors and Engineers — Bridge building, etc. — Shipyards—Marine construction and shipbuilding — Railroads — Timber trestles, etc. — Timber Treating Plants and Pole Yards — Mine Operators — Underground Timbering, etc. — This only begins to show their range of usefulness.

Speed and efficiency are the first requisites of any wartime attack, be it on men, trees or high costs. Air-operated "Wolf" Portable Timber Saws are helping the U. S. Dept. of Agriculture quickly and economically cut down and cut up great numbers of diseased elms . . . a fine object lesson to men who want speed and mobility on timber cutting of *any* kind.

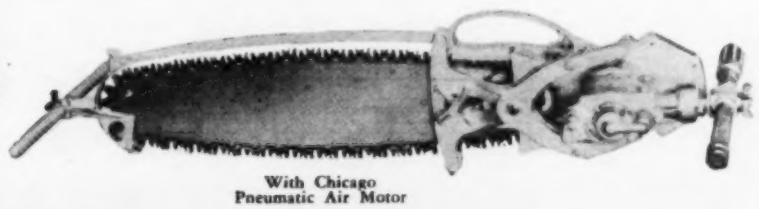
Declare WAR on your Timber Cutting Costs!!!

"Wolf" Portable Timber Saws are not experimental equipment — not untried. They have proved their efficiency and economy since 1927 on big Highway and Bridge and other construction jobs, cutting of piles both above and below water (air driven *only* with divers operating them). "Wolf" Portable Timber Saws are made for Air, Gas or Electric Drive. Their labor saving, rapid action quickly repay their costs — and you'll find no job where timber is used complete without them. Anyone can run a Wolf Saw like a veteran. Made in 16", 24", 36" and 48" capacities. Write today for full information.



With Ingersoll-Rand Air Motor

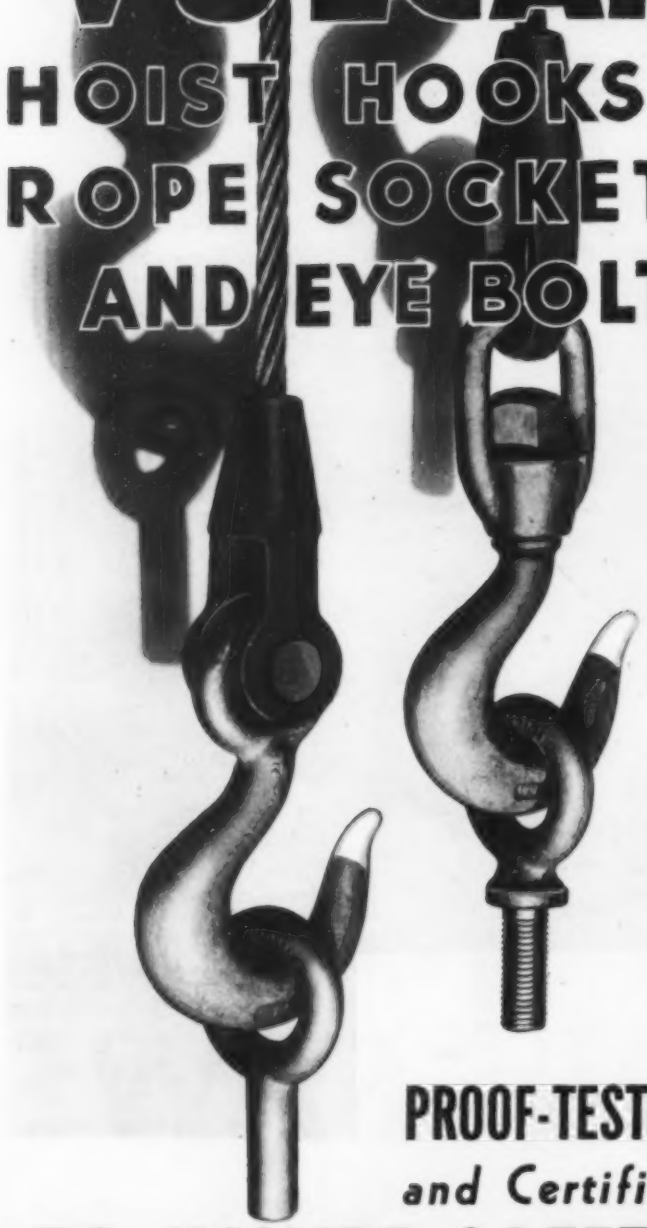
Here are two Air-Driven "Wolf" Timber Saws. Note their compactness, simplicity. Easy to handle, well balanced, safe and fast.



With Chicago Pneumatic Air Motor

REED-PRENTICE CORPORATION
WORCESTER MASS.

"VULCAN"
HOIST HOOKS ROPE SOCKETS AND EYE BOLTS



PROOF-TESTED
and Certified
TO INSURE SAFETY

Drop-Forged from specially selected steel and heat-treated, "Vulcan" Hoist Hooks and Eye Bolts are proof-tested to 50% beyond their rated "safe working load." Hooks in Shank and Eye atterns from 1/2 to 25 tons capacity. Identify them by the orange tip. Eye Bolts in Plain and Shoulder Patterns up to 16 tons capacity.

"Vulcan" Rope Sockets have been proved by test to be stronger, size for size, than the strongest wire rope made. Open and Closed patterns for 1/4 to 1-5/8" wire rope.

J. H. WILLIAMS & CO.
75 Spring Street, New York

Headquarters for: Drop-Forged Wrenches (Carbon and Alloy), Detachable Socket Wrenches, "C" Clamps, Lathe Dogs, Tool Holders, Eye Bolts, Hoist Hooks, Thumb Nuts and Screws. Chain Pipe Tongs and Vises, etc., etc.

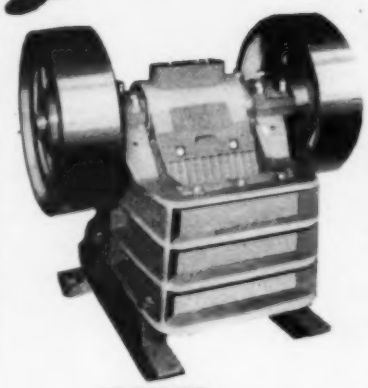
WILLIAMS
SUPERIOR DROP-FORGED TOOLS

ROGERS
JOPLIN

The sign of . . .

Dependability

Our users will tell you about



CRUSHER
sizes — 6" to 36"

The Heavy Rigid Beds

The Big Shafts

The Long Bearings

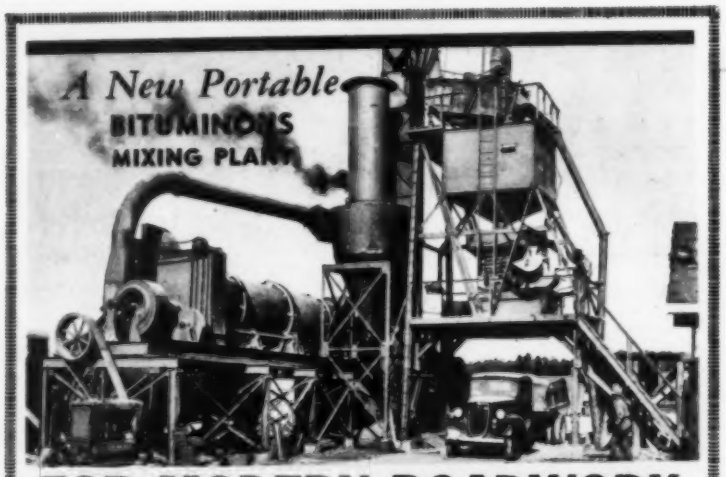
The Perfect Running Balance

The Simplicity of Replacing Wearing Parts

The Unmatched Capacity

In fact ***more Crusher for your Dollar***

ROGERS IRON WORKS CO.
JOPLIN • MISSOURI



FOR MODERN ROADWORK

. . . at Low Cost

This plant was designed to meet the demand for the economical improvement of secondary roads. We have built several to date and they have proved their worth in actual service. No investment is needed for a running gear, plant adapted to standard flat bed truck and trailer hauling.

Some Details

- Can be erected by 3 or 4 men in a few days.
- No erection equipment required. Plant equipped with hoist and jib crane.
- Built in 2 units (dryer unit; and screening and mixing unit).
- Comply with most highway loading and clearance regulations.
- SKF bearings throughout. Fully enclosed vibrating screen. Steam-jacketed, steam-operated steel mixer. Large combustion chamber and dust collector.
- Write for Bulletin T-250.

HETHERINGTON & BERNER, INC.
701-745 Kentucky Avenue — Indianapolis, Ind.

THOUSANDS OF MILES--
YEARS OF SERVICE--
NATIONAL ACCEPTANCE--

Prove

the best all-weather low cost road is Soil Stabilization with CALCIUM CHLORIDE

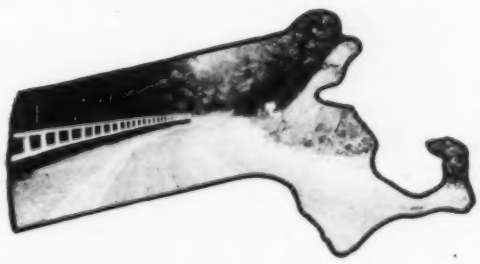
MICHIGAN

Because the ingredients are available at low cost in most communities, and because they provide a year 'round surface as dense as concrete, stabilized soils have become the favorite materials for low-cost roads. From Maine to Missouri, mile after mile of impassable, muddy or dusty roads are being turned into smooth-surfaced, all-year roads. They are stable in winter, dustless in summer – the ideal secondary road.

It's a simple method, too. Gravel, crushed stone or slag from local sources provide wear. Coarse and fine sand fills voids and provides internal friction. Clay, when kept moist, binds the whole mass with a tough, cohesive film. Calcium Chloride regulates the moisture to retain the binding properties of clay.

These materials, in proper proportions, compact under traffic and form a dense, dustless, long wearing, weatherproof secondary road. The secret of the whole system lies in maintaining the moisture film in the clay binder by including proper amounts of moisture-absorbing Calcium Chloride in the mixture. No other chemical or binder gives the same effect.

Methods of building are described in a new 86-page book, "Low Cost Roads." Ask for your copy today.



MASSACHUSETTS

PENNSYLVANIA

CALCIUM CHLORIDE ASSOCIATION

The Columbia Alkali Corporation . . Barberton, Ohio
The Dow Chemical Company . . Midland, Michigan
Michigan Alkali Co., 60 E. 42nd St., New York City
Solvay Sales Corporation, 40 Rector St., New York City

CALCIUM CHLORIDE

FOR STABILIZING ROAD SURFACES

$5.30 OUT OF OUR POCKET or $105 OUT OF THE CUSTOMERS'?

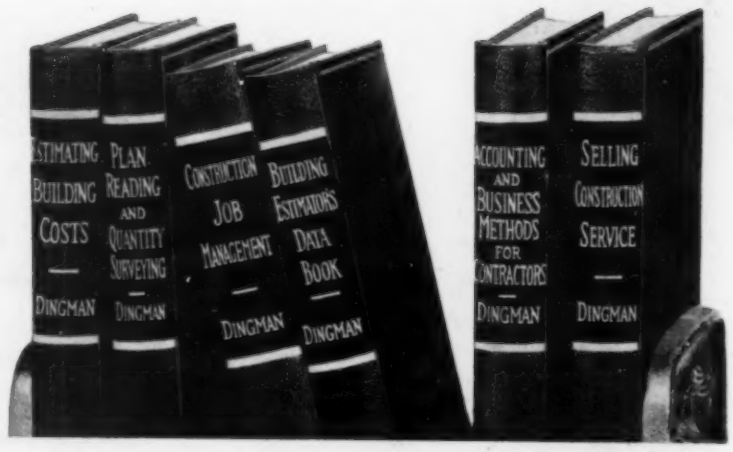
From Knoxville, Tennessee, and Winston-Salem, North Carolina, came orders recently for quantities of RICHMOND FORM-TIES. In each case, under the heading "Ship via" was lettered the word "EXPRESS."

Without presuming to read our own meaning into the customers' instructions, we decided to point out to them that by using Motor Freight instead of Express, they could effect savings totalling $105—and still receive the ties by the dates designated.

In a few minutes we had Knoxville on the long distance telephone—told them the whole story. "Good catch" came the reply, "ship by Motor Freight." Speaking to Winston-Salem, we received a similar reply—and the same expression of appreciation for our watchfulness.

The incidents related above entailed exactly $5.30 in telephone tolls which we were glad to charge off to...experience. It is typical of the lengths to which Richmond goes to give the best possible form-tie service. On your next job, why not try Richmond?

RICHMOND SCREW ANCHOR CO., INC.
Tying Devices for Concrete
241-251 BUSH STREET BROOKLYN, NEW YORK



Practical facts on every phase of building construction!

HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service—from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for

[1] The building contractor who wants a handy reference set that will give him almost instantly a ready answer to most of the problems that come up in the course of the day's work.

[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

[3] Everyone in the building industry who wants to keep his job by increasing his usefulness and efficiency.

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc.—plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

Free Examination—Small monthly payments

Without a cent of expense—without any obligation on your part—you may examine the Dingman Building Contractors' Library for 10 days and determine its value for yourself. Try the books out on your everyday problems—make them prove their worth to you. Unless they meet every test send them back at our expense. If the books prove satisfactory and you decide to keep them, pay only $1.50 in ten days and then $2.00 a month for six months.

Every contractor and builder, every architect and engineer, every student and executive, who is seeking practical help on the everyday problems connected with building construction work should have this valuable reference library.

McGRAW-HILL
FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York, N. Y.

You may send me for 10 days free examination, the new six-volume Dingman BUILDING CONTRACTORS' LIBRARY. I agree either to return the books postpaid at the end of 10 days or send a first payment of $1.50 then and $2.00 a month for six months.

Signed .....

Address .....

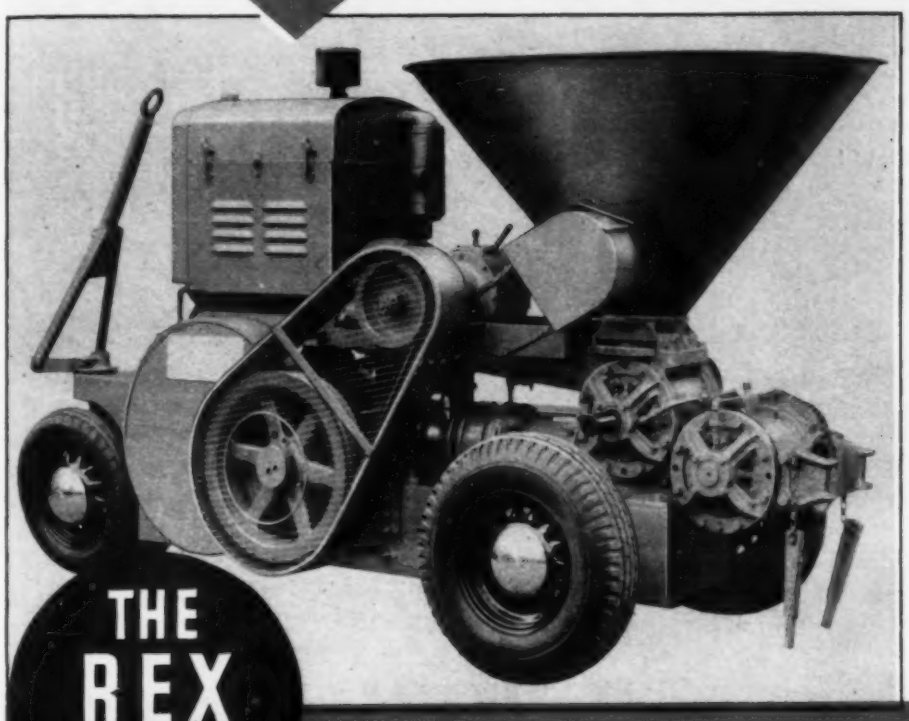
City and State .....

Official Position .....

Name of Company .....

(To insure prompt shipment, write plainly and fill in all lines.) CM&E. 6.-37

HERE'S *what youve been waiting for!*



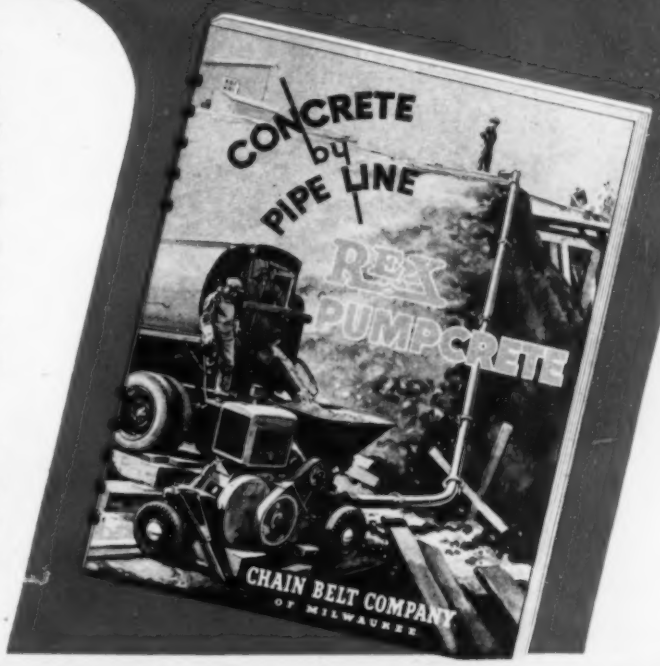
A SMALL, LOW COST CONCRETE PUMP!

Here's the Pumpcrete that will help you get more small jobs per year—do them faster—and at a greater profit. It is light—fast moving—low cost—in answer to the demand for a small Pumpcrete that is designed and built specifically for jobs of less than 5000 cubic yards. It will deliver from 15 to 20 cubic yards per hour into the forms—cheaper, faster and easier—on a wider variety of jobs and it's backed by Pumpcrete's reputation of over 4,000,000 yards placed in less than five years.

AND A BOOK THAT TELLS WHY IT PAYS *to Forget the Old Stuff!*

This new Pumpcrete Catalog contains complete information on the design and operation of the Rex Pumpcrete. There's a 26-page rotogravure section that shows the Rex Pumpcrete in action on every size and type of job—with statistics on the yardage placed and the setup used. It has a list of Pumpcrete users that reads like the "Blue Book of American Contractors." It includes everything from pipe line handling to specifications. Read it—and be convinced that it pays to forget the old stuff in favor of the Rex Pumpcrete.

See our representatives or write our home office for your copy of this catalog and for further information on the new Rex 160 Pumpcrete. When writing, please give your name, your company's name and your present position.



CHAIN BELT COMPANY, 1664 W. Bruce St., Milwaukee, Wis.

THE UP-TO-DATE METHODS OF HANDLING CONCRETE

REX **PUMPCRETE**

CHAIN BELT COMPANY *of Milwaukee*

G&R PUMPS will NOT clog -SELF priming

When a deliberate attempt to clog a G & R Self Priming Centrifugal by shoveling muck, gravel and cinders right into the strainer fails to even slow down the flow of water through the pump, there isn't much chance of the pump being clogged in any service where you may use it.

In the photograph reproduced here, you see a regular 2 inch G & R Pump being given just that kind of a test. No matter how dirty the water was that the pump was called upon to handle, it never once failed to pick up prime the minute the suction hose went into the water. How would the usual self-priming pump, with its jet or orifice clogged with sediment by such a test, compare to the 100% performance of the G & R?

Because there is no restricted by-pass or recirculating orifice in the G & R Pump to clog, you will always find it handling water at maximum efficiency. Don't buy any pump this year with your eyes shut. Compare them all with the G & R.

Distributors in 100 principal cties are ready to make prompt delivery of the G & R Pumps you need.

The MOST DEPENDABLE Pump for the least money

● THE GORMAN-RUPP COMPANY—MANSFIELD, O. ●

--to make Dirt Moving Pay

BLAW-KNOX
(ATECO) HYDRAULIC
BOTTOMLESS
SCRAPERS

The dependable performance of Blaw-Knox (Ateco) Hydraulic BOTTOMLESS SCRAPERS keeps dirt moving costs *down*—enables the contractor to operate his job on a definite schedule and at a profit.

It will pay you to investigate this BOTTOMLESS SCRAPER—also the Blaw-Knox (Ateco) Sheepsfoot TAMPING ROLLER.

Send for catalog

BLAW-KNOX COMPANY
2086 Farmers Bank Bldg, Pittsburgh, Pa.

Please send:—CATALOG No. 1540—Blaw-Knox (Ateco) BOTTOMLESS SCRAPERS ☐

Please send:—CATALOG No. 1550—Blaw-Knox (Ateco) Sheepsfoot TAMPING ROLLERS ☐

Individual .....

Company .....

Street .....

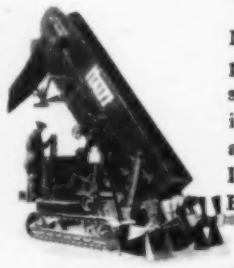
City ..... State .....

USE COUPON

THE BUSINESS END OF A

HAISS LOADER

TELLS A WHOLE STORY



No other Loader has Haiss Self-feeding Propellers working with a worm-driven slow speed crowding gear — and that combination is the secret of efficient digging. Your further advantage is that every element of Haiss Loader design is equally simple and efficient. Before you buy a Loader BE SURE TO READ HAISS BULLETIN 134.

Represented in all Principal Cities

GEORGE HAISS MFG. CO., INC.
139th St. & Canal Place, New York

ASK FOR BULLETIN 237 ON FAMOUS HI-POWER CLAMSHELL BUCKETS

1400-GALLON "TAXI" HAULS GOLDFISH

A TRUE "FISH STORY"

By LOWELL THOMAS

"Talk about strange cargoes. Listen to this true 'fish story. Out in Martinsville, Ind., is the world's largest goldfish hatchery. The principal market, New York City, is a thousand miles away. To make this jump the Grassyfork Fisheries built a special tank truck, a ten-tire giant that can haul 200,000 fish in one load.

"To protect this precious shipment, the truck is heavily insulated. A special engine drives a compressor, forces a constant stream of air through the 1400 gallons of water.

CAN'T TAKE CHANCES

"Once a week in zero-weather January or broiling July this big truck makes the eastward journey. Carries fish for the East, rare specimens to go aboard Atlantic liners. They must 'bring 'em in alive.' Delays would be costly. You can't take chances on tire failure with a job like this.

"But they tell me they just don't have tire trouble with Goodrich Triple Protected Silvertowns. Not one sidewall failure! And they run up tremendous mileages.

"In all my travels I've noticed that on the toughest trucking jobs you usually find Goodrich Silvertowns."

* * *

Lowell Thomas is right! Where the going is hardest Goodrich is first choice. Goodrich Tires are being tortured in heavy forests under crushing log loads of 15 and 20 tons, through burning deserts on fast schedules at 130° temperatures—over jagged rock in coal mine operations—in the army through ditches and underbrush, *on no road at all!* And they take this punishment in their stride.

Goodrich Silvertowns are Triple Protected in the sidewall—built with an invention that checks 80% of all premature failures. Only Goodrich gives you this 3-way safeguard:

1 **PLYFLEX**—distributes stresses throughout the tire—prevents ply separation—checks local weakness.

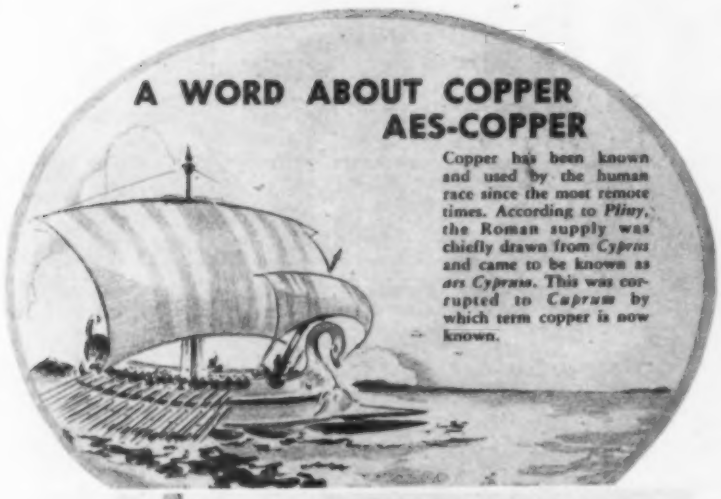
2 **PLY-LOCK**—protects the tire from breaks caused by short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—eliminates cross cords from *all* plies—reduces heat in the tire 12%.

On *your* trucks, too, you can get a new freedom from road delays and big repair bills and at the same time increase mileage with Triple Protected Silvertowns. See the Goodrich dealer and start saving. Or write The B. F. Goodrich Co., Akron, Ohio and Los Angeles, Calif.

Goodrich *Triple Protected* **Silvertowns**

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES


A WORD ABOUT COPPER
AES-COPPER
Copper has been known and used by the human race since the most remote times. According to *Pliny*, the Roman supply was chiefly drawn from *Cyprus* and came to be known as *aes Cyprus*. This was corrupted to *Cuprum* by which term copper is now known.

AND TODAY... *at the* TENNESSEE COPPER CO.

The advance in metallurgical knowledge is clearly exemplified. What were once useless by-products of copper are now converted to profitable use. Although Tennessee Copper Company does ship some copper, its main product is sulphuric acid.

This company is famous for the excellence of its organization and for its efficiency. Every operation is carefully supervised and its safety department is one of the finest in the country.

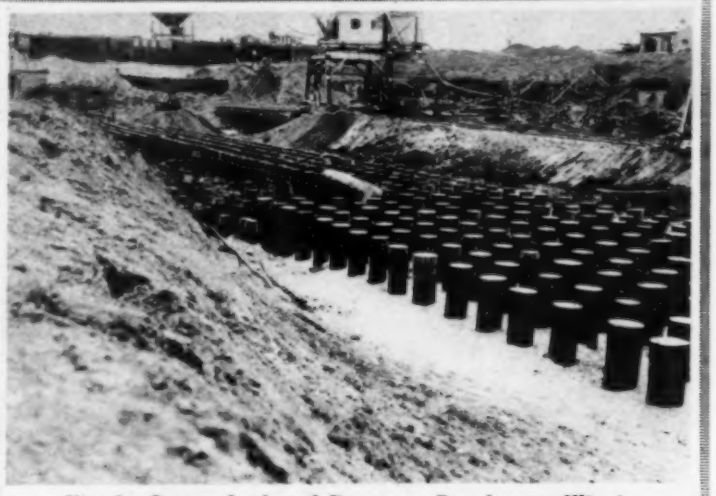
As a result of constant attention to detail, misfires in the mines have been reduced to a minimum.

Ensign-Bickford Safety Fuse is used throughout blasting operations, for like hundreds of other operators, Tennessee Copper has learned that Ensign-Bickford Safety Fuse is dependable.

Ensign-Bickford Safety Fuse is made under rigid laboratory control—to definite standards established after a century of experience and research. Like the Tennessee Copper Company, Ensign-Bickford stands for Quality—Preparation—Knowledge. Safety Fuse is always available in a number of standardized brands, each made for a particular set of conditions.

Write for the Safety Fuse Book. It shows how most blasting troubles and accidents may be avoided.

ENSIGN-BICKFORD SAFETY FUSE
THE ENSIGN-BICKFORD CO.
SIMSBURY, CONNECTICUT
SF65



New La Grange Lock and Dam near Beardstown, Illinois

No One Wears Rubber Boots On a MORETRENCH JOB!

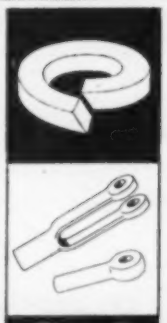
"It is without doubt the driest cofferdam I have seen," writes the Chief Engineer on this project — and he has had plenty of experience.

Moretrench Pumps, Moretrench Wellpoints, and Moretrench careful installation mean the *utmost* in speed, comfort, and economy. There are many reasons.

MORETRENCH CORPORATION

Sales and Rental Office:
90 West Street, New York

Plant:
Rockaway, New Jersey

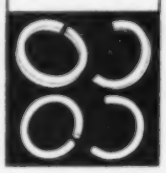


SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

STEEL ROD ENDS

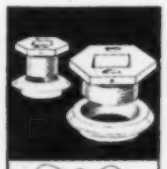
Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.



RETAINING RINGS

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

STEEL BARREL CLOSURES



Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

CONTAINER HANDLES

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

* * * * * *

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY
NEWARK, N.J.—EXPORT DIV., 15 E. 26 St., N.Y.C.

NEW 1937
CHEVROLET TRUCKS

Greatest Pulling Power of Any Trucks in the Low-Price Field

CHEVROLET
FOR ECONOMICAL TRANSPORTATION

Contractors and builders whose haulage requirements call for powerful truck units recognize the superior advantages of new Chevrolet 1½-ton trucks. For a combination of power and flexibility they are unmatched; for money-saving economy they are unequaled.

Chevrolet's New High-Compression Valve-in-Head Engine is a marvel of efficient, responsive power—the greatest pulling power of any low-priced truck. And just as important are the extra payload miles you get from a gallon of gasoline, the extra miles you get from every quart of oil.

Unmatched Economy Proved in 10,244-Mile

"RIM OF THE NATION" TEST RUN

With Half-Ton "Economy Model" Pickup—1,000-Pound Load.

Location of Test	"Round the Nation, Detroit to Detroit
Distance Traveled	10,244.8 Miles
Gasoline Used	493.8 Gallons
Oil Consumed	7.5 Quarts
Water Used	1 Quart
Gasoline Cost	$101.80
Gasoline Mileage	20.74 Miles per Gallon
Average Speed	31.18 Miles per Hour
Running Time	329 Hours, 31 Minutes
Gasoline Cost per Mile	$.0098
Average Oil Mileage	1,365.9 Miles per Qt.
Total Cost of Repair Parts	$0.73

These records have been certified by the A.A.A. Contest Board as being officially correct.

Then, too, there's an extra measure of economy in long-wearing Chevrolet Perfected Hydraulic Brakes—the safest and smoothest ever developed. So it is with every important feature—frame, rear axle and transmission . . . they are built for hard service—thoroughly dependable, and leading in the economy of service they perform.

Take the step to greater truck satisfaction. See your Chevrolet dealer, and ask for a demonstration of 1937 Chevrolet trucks.

General Motors Installment Plan—monthly payments to suit your purse.

CHEVROLET MOTOR DIVISION
General Motors Sales Corporation
DETROIT, MICHIGAN

"MORE POWER per gallon LOWER COST per load"

Accuracy
THE KIND YOU WANT .... AND NEED

THIS YEAR CONTRACTORS ARE SAYING IT WITH ORDERS FOR

Buckeye Surface Material SPREADER

It took them just part of one season to find out what *accuracy* in spreading really means. When the specifications call for 20 lbs. per sq. yd., the Buckeye Spreader lays down 20 lbs. on every sq. yd. of surface to be covered. No guessing, no clean-up gang needed to smooth up edges or touch up thick and thin spots. It does the job RIGHT THE FIRST TIME OVER, spreads any material from sand to 1" stone, wet or dry and lays down a spread of any desired thickness from a mere sprinkle to 60 lbs. per sq. yd.

Coupled to the loaded truck or detached in a few seconds when truck is empty. Truck hitch holds the spreader squarely in line with truck so that spreading is done as readily when backing for seal coat work, as when the truck is moving forward. Variations in speed of operation do not interfere with accuracy of spread.

Be sure you see a Buckeye and know what it will save on *your* job before you buy any spreader this year.

THE BUCKEYE TRACTION DITCHER CO.
FINDLAY, OHIO

C.H.&E.

PORTABLE SAW RIGS
5 sizes

SELF-PRIMING CENTRIFUGAL PUMPS
9 sizes

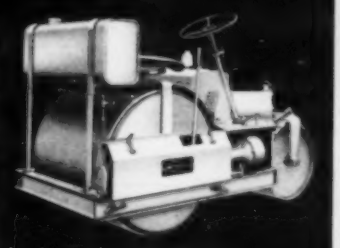
DIAPHRAGM, PISTON and TRIPLEX PUMPS
9 sizes

SINGLE & DOUBLE DRUM HOISTS
10 sizes

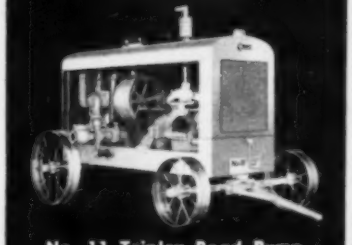
MATERIAL ELEVATORS
MORTAR MIXERS
BAR BENDERS
BAR CUTTERS
TWO TON ROLLERS

WRITE for our COMPLETE CATALOG

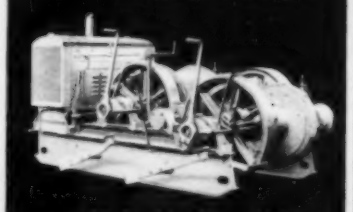
C.H.&E. MANUFACTURING CO.
3839 — No. Palmer St.
Milwaukee, Wis.



Two Ton Roller



No. 11 Triplex Road Pump

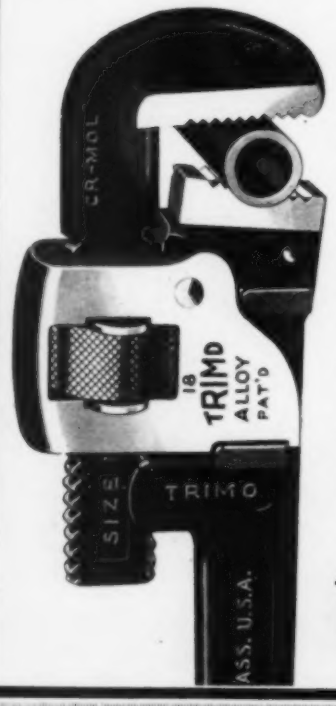


No. 28 Double Drum Hoist

TRIMO

HAS FOR FIFTY YEARS MEANT ONE THING TO WRENCH USERS EVERYWHERE

STANDARD QUALITY



Trimo quality means a construction of Chrome Molybdenum Nickel Alloy Steel — hard gripping jaws — strength, safety, and economy wherever wrenches are used throughout industry.

TRIMONT MFG. CO., Inc.
Roxbury (Boston), Mass.

New TRIMO ALLOY PIPE WRENCH

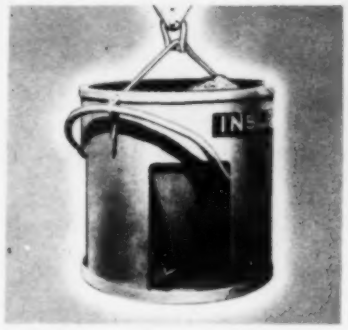
The Red Tag, always attached to every Trimo, identifies Standard Quality.

SPEED means EXTRA PROFITS

These INSLEY TIME SAVERS are MONEY-MAKERS for CONTRACTORS

INSLEY ROCKER-DUMP HAND CART

Sizes 6-9-12 cu. ft. Rocker construction gives a clean dump in vertical position. Cart will not roll while being dumped. Pneumatic tires and roller bearings make it easy to push. Stub axles carried in the frame, welded integrally with the tray. Tray completely welded, amply reinforced, free from obstruction. Ask for details and prices.



INSLEY ROUND-TYPE CONTROL-LABLE CENTER-DUMP BUCKET

Positive control at every stage of dumping. Round apron for constant ground support. Handle at the end of the bucket makes it easy to spot the load. Made in two types: Narrow gate for restricted forms; Foundation Bucket with square gate for large masses. Write for complete information and prices.

INSLEY SEMI-TRAILER DUMP WAGON

Hauls twice as much dirt as ordinary dump trucks, thus doubling the capacity of the fleet on dirt moving jobs. Center dump allows a quick get-away . . . strongly built for long service . . . reasonably priced. Ask for complete specifications.

All Insley Products
Are Soundly Engineered, Rightly Priced
and Nationally Serviced

INSLEY MANUFACTURING CORP., INDIANAPOLIS, INDIANA

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ok it's an ABW Solid Shank

Built *to last!*

Here's the reason there is more handle strength to an ABW Solid Shank shovel than the ordinary solid shank shovel. It is the famous ABW Shock Band, giving double thickness of steel at the point of greatest strain in the handle. A patented feature only on ABW Solid Shanks.

ASK YOUR JOBBER

SINCE 1774

AMES BALDWIN WYOMING CO.
PARKERSBURG, W. VA. NORTH EASTON, MASS.

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RED EDGE
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A Complete Line of Pumps for Every Purpose

Sizes From 2 to 10 Inches

Capacities up to 200,000 G.P.H.

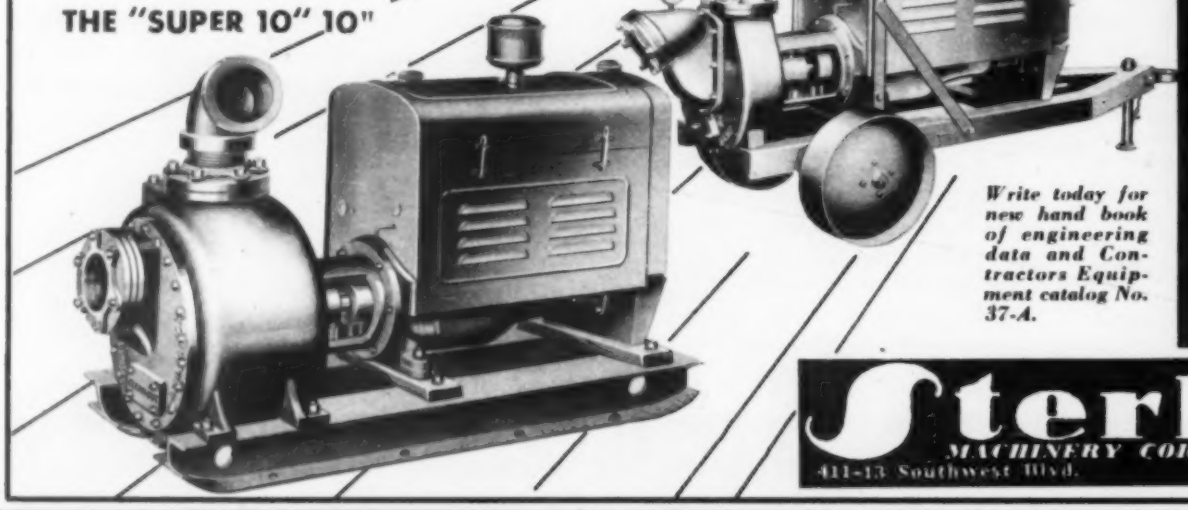
One improved design for all sizes-round symmetrical pump case, adjustable open trash type impeller, no unbalanced valves, no screens, no tanks or no gadgets. Close grained wear resisting nickel semi-steel pump case, side and impeller. Impeller shaft mounted on Timken Roller Bearings or on larger sizes on heavy-duty ball bearings.

THE LIGHTWEIGHT 2"

Single stage jetting pumps, Multistage pumps. Hoists up to 8000 lbs. single line pull, Electric Generating Plants as large as 150 K.W., Saw Rigs.

THE BRIDGE BUILDERS 4"

THE "SUPER 10" 10"



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Sterling
MACHINERY CORPORATION
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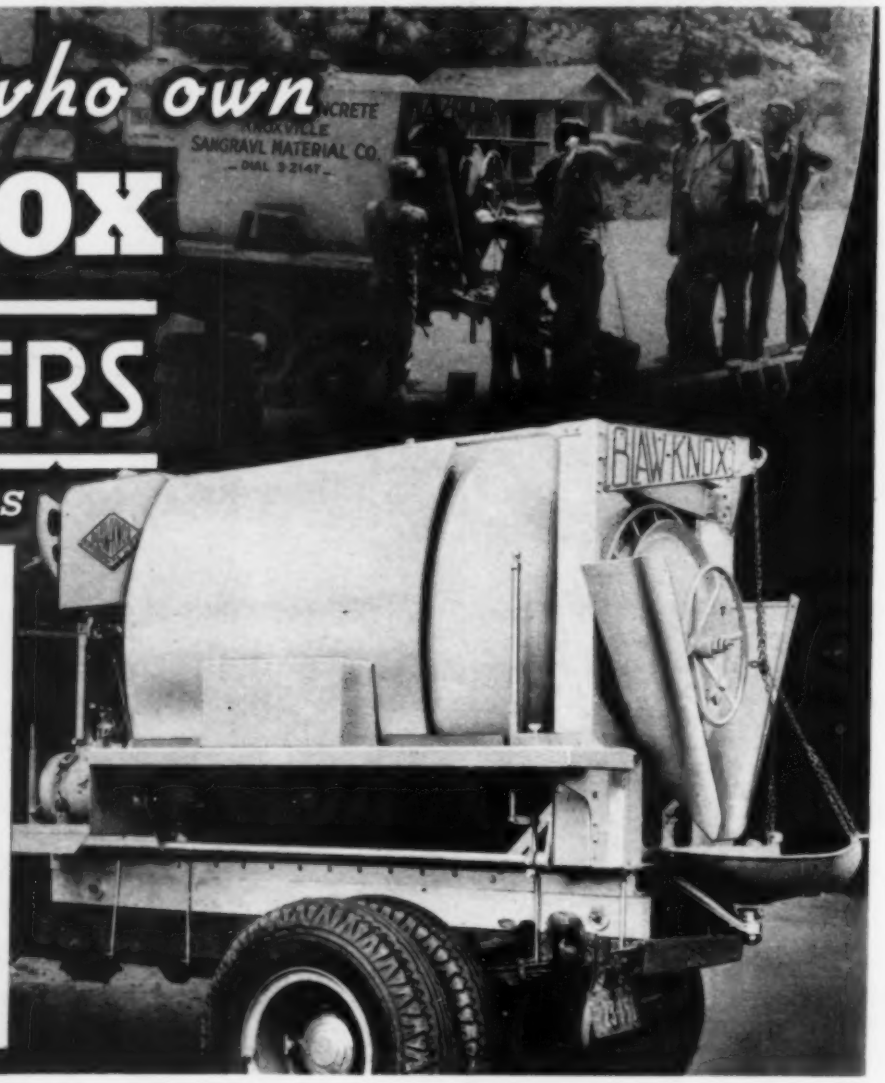
Ask the men who own

BLAW-KNOX TRUKMIXERS

and Agitators



★ Somewhere near you a Blaw-Knox TRUKMIXER user is making better concrete and getting bigger profits from his concrete business.

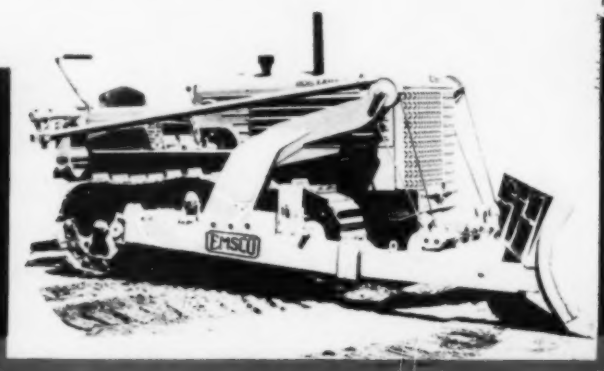
If increased profits from ready mixed or truck mixed concrete interest you, get in touch with Blaw-Knox for the only complete equipment service available—including TRUKMIXERS, AGITATORS, AGGREGATE BATCHING PLANTS, BULK CEMENT PLANTS, CENTRAL MIXING PLANTS.

BLAW-KNOX COMPANY
2086 FARMERS BANK BLDG., PITTSBURGH, PA.
Offices and Representatives in Principal Cities

Versatility

The exceptional versatility of Emsco Bulldozers and Trailbuilders is clearly shown by the illustrations here. The upper view shows an Emsco Trailbuilder easily handling frozen earth in twenty below zero weather in Minnesota. In the circle, an Emsco Bulldozer working on the desert near Palm Springs, California where the temperature registers as high as 140 degrees during the summer.

Below: Emsco Cable Controlled Trailbuilder on Cletrac Model DD Streamline Tractor.



OTHER EMSCO TRACTOR EQUIPMENT

Cable And Hydraulic Controlled Bulldozers - Trailbuilders - Rippers - Scrapers - Power Control Units

EMSCO

EMSCO DERRICK & EQUIPMENT COMPANY

TRACTOR EQUIPMENT DIVISION

General Offices and Plant: 6701-7101 South Alameda Street, Los Angeles, California

Eastern Sales Office: 332 South Michigan Avenue, Chicago, Illinois

JUST PRESS THE BUTTON

FOR INSTANT AIR POWER

SCHRAMM 105 DeLuxe "Utility" Compressor. Insert showing instrument panel with gauges and starting button.

For the first time, SCHRAMM "Utility" Portable Compressors present electric self-starting equipment as a standard feature. Self-Starting means air on the job in a few minutes with time and labor saved in addition to the feature of safety. SCHRAMM "Utility" Compressors are available in sizes 85, 105, 160, 210, 260, 315 and 420 cu.ft. actual air deliveries and can be mounted on any one of seven mountings.

Write for SCHRAMM Bulletin 3700-CJ.
SCHRAMM INC., West Chester, Penna.

SCHRAMM

AIR COMPRESSORS

K&E
WYTEFACE
STEEL MEASURING TAPES

for VISIBILITY!

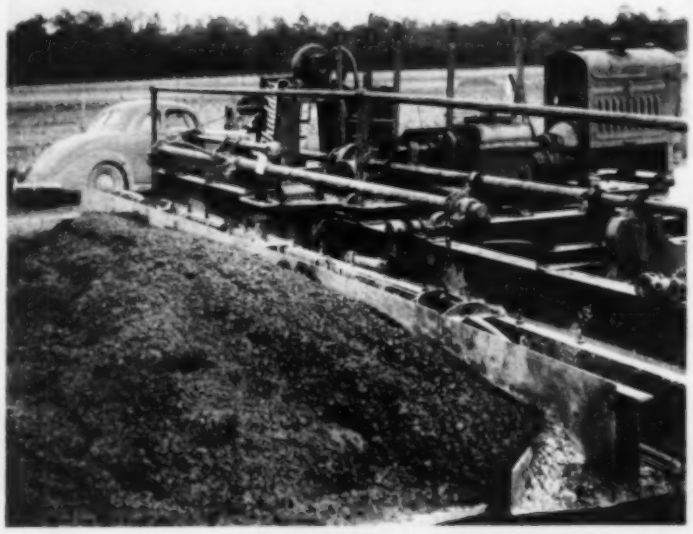
This improved steel tape makes life easier for the man on the job. The clear, black-on-white graduations are a decided convenience, and a valuable safeguard against annoying errors.

And WYTEFACE is serviceable. A new resilience prevents kinks or curls; a crack-proof surface protects the steel from rust — exclusive WYTEFACE features that greatly increase the useful life of the line.

You'll want to own a WYTEFACE Steel Tape. Ask your dealer, or write for complete information.

KEUFFEL & ESSER CO.
EST. 1867 HOBOKEN, N. J.
NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO DETROIT MONTREAL

"DO YOU KNOW?"



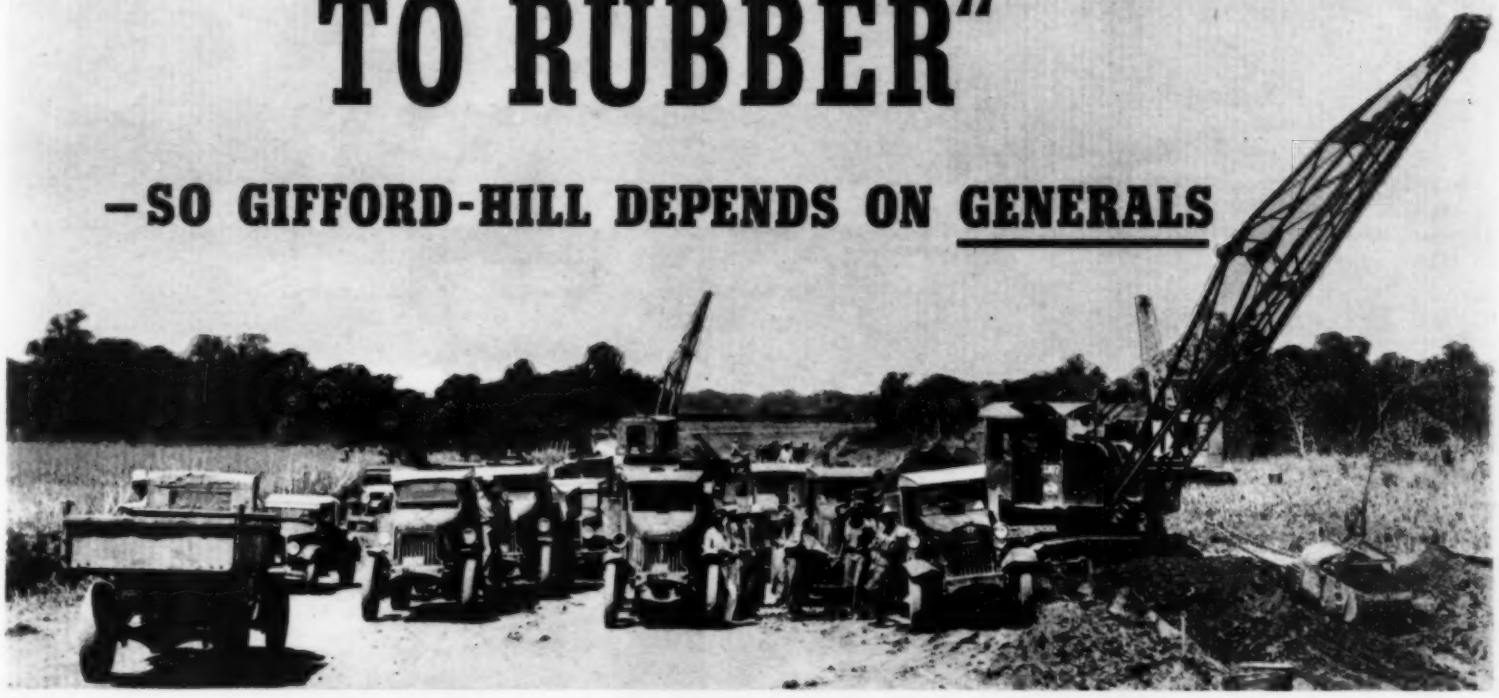
The wide screed finishing machine is winning laurels everywhere. It produces an unbelievable smooth surface. Back screeding is only one of its features. Don't forget our contraction joint equipment.

FLEXIBLE ROAD JOINT MACHINE CO.

WARREN • OHIO

"PLENTY OF PUNISHMENT TO RUBBER"

—SO GIFFORD-HILL DEPENDS ON GENERALS



● Gifford-Hill and Company, Inc., railroad contractors of Texas and Louisiana, work almost continuously on railroad building, repairing and line changing.

"The fleet of 18 trucks and approximately 75 passenger cars used in our construction work must meet the same rigid requirement for dependability as our locomotives and dredging machines," declared Robert Whitten, purchasing agent. "For this reason, ninety-eight percent of the tires we buy are Generals. The missing two percent represents emergency purchases made necessary when bad luck overtakes one of our drivers so far from the nearest General dealer that he has to take another tire in order to get back in.

"Often our trucks and cars must operate through broken country where there are no roads at all. Such conditions mean plenty of punishment to the rubber. Therefore, we specify General tires because they can take plenty of rough treatment. But there is another factor which influences our choice of General tires. That is the fact that General Tire distributors stand back of their product. Past experience has taught me that I can depend upon the men back of General Tires for fair play just as I can depend upon General Tires to deliver the goods."

Your General Tire dealer has a complete, specialized line of truck tires. He is a practical truck man with wide experience and knowledge. He can save you money. Call him in.

GENERAL
TRUCK TIRES

THE GENERAL TIRE & RUBBER COMPANY
AKRON, OHIO

In Canada—The General Tire and Rubber Co. of Canada, Limited, Toronto, Ontario

GREATEST OBTAINABLE TRACTION

for excavation and oil field trucking, road machinery and all other heavy off-the-road work.

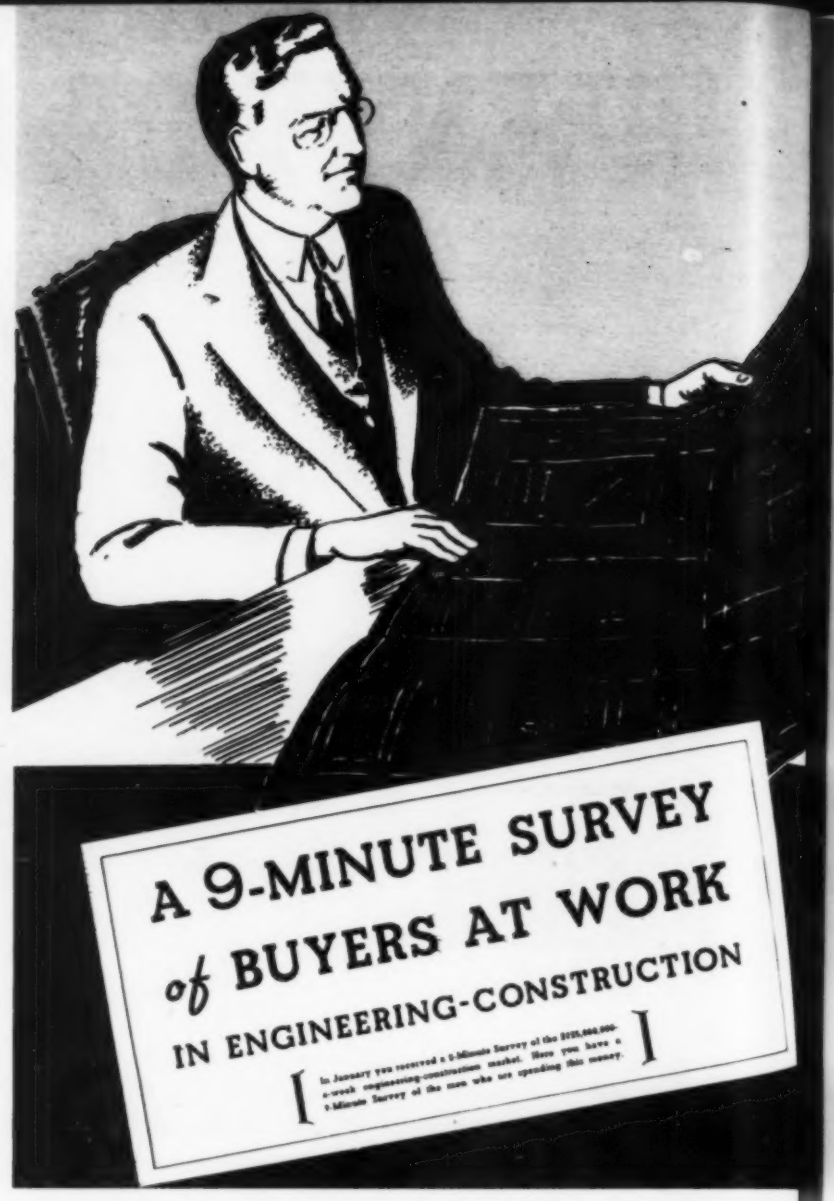
NEW HEAVY DUTY CLEATED TRACTOR GENERAL

1. Deep cut "Chevron" tread is practically slip-proof in soft going.
2. Tread is self-cleaning in mud and sand.
3. Center riding rib, for smooth rolling and slow wear when running on hard surfaced roads.
4. Stronger, because of two extra plies running from bead to bead.
5. Cooler running due to patented *no-breaker-strip construction*.
6. Heavy dual and triple-cable beads.

A 2-MINUTE SURVEY of 1937 PROSPECTS

which mean business for you in the heavy construction industry

BASED ON
- 1936 TRENDS



EXACTLY 11 MINUTES

To Appraise This 6½ Billion-Dollar Market and Its Buyers

YOURS FOR THE ASKING

2 MINUTES

● This brochure is a graphic presentation of the engineering-construction industry. In picture and chart it breaks the market into its main divisions and shows where each division is heading in 1937. Commenting on the presentation, **Advertising & Selling** says it's a funny thing but the truth that it takes only two minutes to get a grasp of this 6½ billion-dollar business. Several manufacturers have had the study sent to their salesmen and distributors.

9 MINUTES

● Hot off the press, this follow-up brochure identifies the men who are participating in the spending of the 6½ billions. Examples of buying habits and actual purchases are given. It enables one to trace the sale of an item down through all the various factors involved. The proofreader claims it takes only 8 minutes to read it but allowance is made for the fact that he is a ~~professional~~ reader.

Either or both brochures will be sent upon request, with the compliments of CONSTRUCTION Methods and Equipment, McGraw-Hill Publishing Company, Inc., 330 W. 42nd St., New York, N. Y.

World Famous!

TESTED AND PROVED

"RPM" DIESEL ENGINE LUBRICATING OIL

"Caterpillar" Diesel operators in all parts of the world are telling again and again the sensational story about "RPM" Diesel Engine Lubricating Oil—*the PATENTED* oil that made history—world-wide acceptance in eight months!*

Now-

FOR "CATERPILLAR" DIESELS

A HISTORY-MAKING DISCOVERY!

This big discovery will save you real money in the operation of your "Caterpillar" Diesel equipment — its world-famed name is *"RPM" Diesel Engine Lubricating Oil!*

It's the *first* oil to end ring-sticking and it made history by winning world-wide acceptance in 8 months.

No conventional or so-called Diesel engine lubricating oil had ever been used before in "Caterpillar" Diesel engines that accomplished the spectacular heavy-duty performance of "RPM" Diesel Engine Lubricating Oil! It keeps the cylinders, rings and bearings *clean!* It eliminates expensive carbon-removal overhauls and consequent time losses on the job.

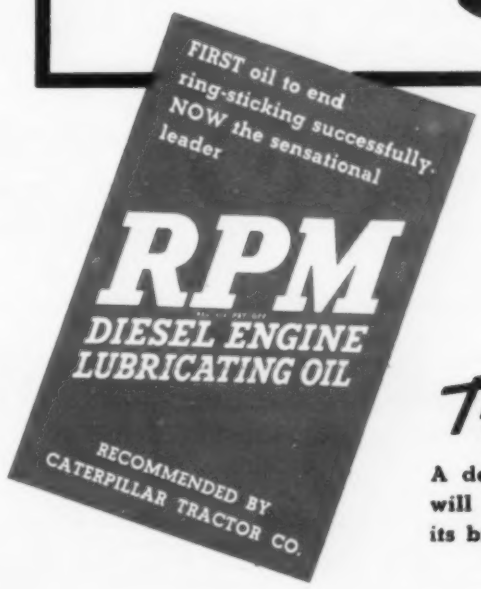
This sensational money-saver is an exceptionally fine lubricant with the high film strength needed to protect the bearing surfaces during heavy-duty operations.

If you haven't tried it yet — don't lose any time giving it a good hard test. You'll see why Caterpillar Tractor Co. gives this oil its unqualified endorsement.

*U. S. Patent No. 2,001,108 Other Patents Pending

THOUSANDS OF HOURS

After operating under heavy load for thousands of hours on "RPM" Diesel Engine Lubricating Oil all rings on this "Caterpillar" Diesel piston moved freely at the touch of a finger. Had the engine been run only five minutes it couldn't have been cleaner!


FIRST oil to end ring-sticking successfully. NOW the sensational leader
RPM
DIESEL ENGINE LUBRICATING OIL
RECOMMENDED BY CATERPILLAR TRACTOR CO.

Try it!

A demonstration will soon prove its big economy.

Ends ring-sticking

For Further Information
Consult any of the Following Companies:

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California Standard Oil Company
California Standard Oil Company de Mexico
Carter Oil Company, The, Tulsa, Okla.
Colonial Beacon Oil Company, Inc.
Humble Oil & Refining Company
Imperial Oil Limited
Standard Oil Company (Indiana)
Standard Oil Company (Incorporated in Kentucky)
Standard Oil Company (Nebraska)
Standard Oil Company (Ohio), The
Standard Oil Company of British Columbia Limited
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Standard Oil Company of Louisiana
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How to design reinforced concrete structures

Here is the revised fourth edition of a well-known manual of fundamentals for the reference use of practicing designers and engineers. The book presents detailed principles, data, tests, and construction facts relating to the materials of reinforced concrete construction, and explains, with many examples, the design of all the simple elements of this type of construction.

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New Revised Fourth Edition

Reinforced Concrete Construction

Vol. 1—Fundamental Principles

By GEORGE A. HOOL
Formerly Professor of Structural Engineering, University of Wisconsin

Revised by HARRY E. PULVER
Professor of Civil and Structural Engineering, University of Wisconsin

454 pages, 6 x 9, 162 illustration, $4.00

THIS VOLUME, complete in itself, forms the first part of a three-volume set that presents a simplified yet authoritative and adequate treatment of the design and construction of reinforced concrete structures, especially adapted to the needs of practicing engineers and of those who wish to study this subject at home.

Part I covers materials, including the design of a concrete mixture, tests for the control of concrete on the job, properties of concrete and steel separately and in combination, details of bonding, behavior of reinforced concrete under tension, etc.

Part II gives theory, tests, methods, data, etc., relating to the design of a number of elements such as simple rectangular beams, beams with tension and compression reinforcement, slab, cross-beam, and girder floors, columns, footing, etc.

Look up in this book:

- selection of water-cement ratio for durability
- design of a trial concrete mix
- contraction and expansion
- shrinkage and temperature stresses
- flexure formulas for working loads
- tests on shrinkage and plastic flow
- conditions met with in design of T-beams
- kinds of buildings for which flat slab floors are economical
- tests of composite and combination columns

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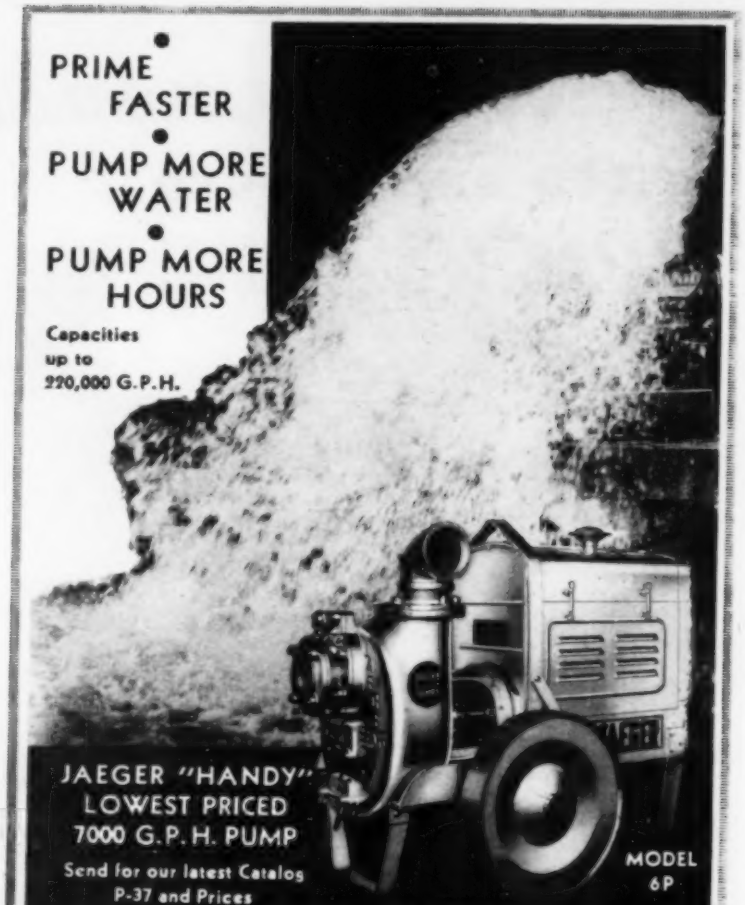

JAEGER "HANDY" LOWEST PRICED 7000 G.P.H. PUMP

Send for our latest Catalog P-37 and Prices

MODEL 6P

JAEGER "SURE PRIME" PUMPS

THE JAEGER MACHINE CO.
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BETTER PERFORMANCE
LONGER SERVICE
ON ANY JOB

"DIXON" AIR HAMMER COUPLINGS

Designed and built to withstand the continual vibration of hand hammers and rock drills, this Dixon coupling has a longer, consistently economical service life on the toughest job. And, like the "Boss," it is rust-proofed by Cadmium Plating.

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Used for steam hose, steam hammers, air, hydraulic or road builders' hose . . . "Boss" Couplings have no equal for dependability in service. Parts are of steel or malleable iron to withstand abuse . . . Cadmium Plated for rust proofing.

Furnished in Washer or Ground Joint Type.

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VALVE & COUPLING CO.
LOS ANGELES PHILADELPHIA HOUSTON

Carried in Stock by Leading Rubber Manufacturers and Jobbers.

1. More re-uses — 30 to 50 times.

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Mail coupon now for full information about this remarkable new 1937 building material.

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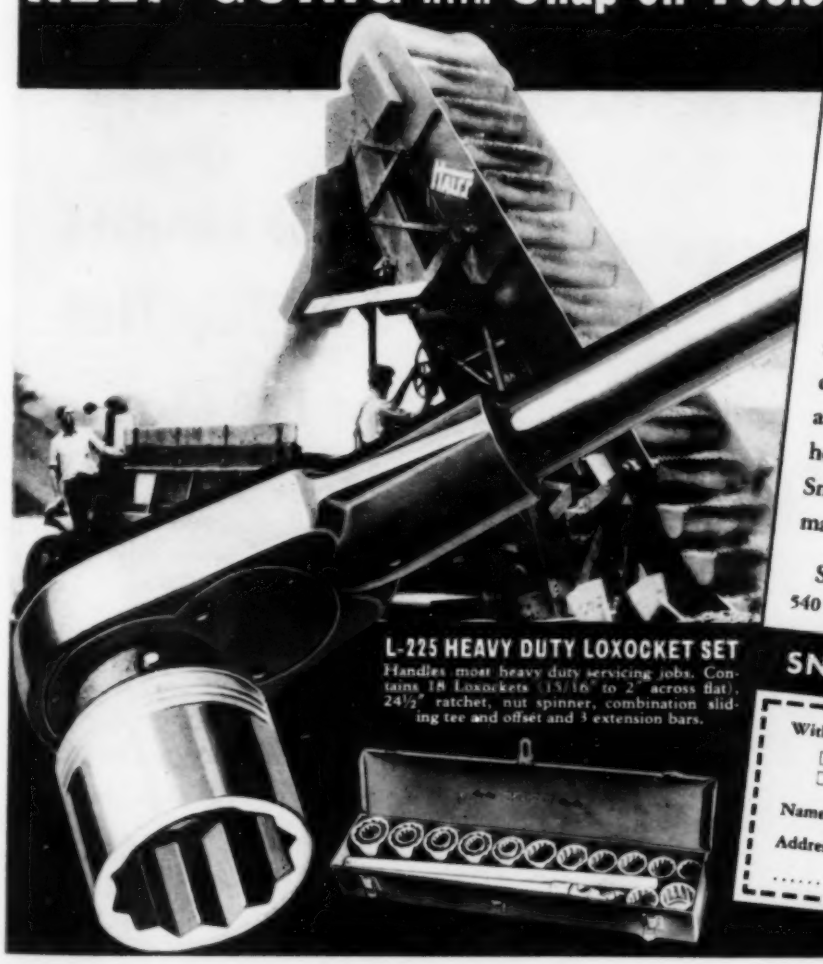
BIG TOOLS FOR TOUGH JOBS

Snap-on's Heavy Duty wrenches will safeguard your profits by making short work of repairs and adjustments.

Your men will like Snap-on's Heavy Duty wrenches . . . they're stronger . . . heavier . . . safer! They've got the power to break loose tight rusted on nuts and they'll speed up the heavier nut turning jobs.

Keep going with Snap-on Tools . . . over 1700 of them shown in our 1937 catalog of 136 pages. Write for your copy. Snap-on builds a complete line of hand tools . . . available through its own distributing warehouses located in 37 principal cities. See Snap-on Tools in your phone directory or mail coupon below.

SNAP-ON TOOLS, Inc., Kenosha, Wis.
540 Service Salesmen — 37 Branch Warehouses



L-225 HEAVY DUTY LOXOCKET SET
Handles most heavy duty servicing jobs. Contains 18 Loxockets (15/16" to 2" across flat), 24½" ratchet, nut spinner, combination sliding tee and offset and 3 extension bars.

SNAP-ON TOOLS, INC., Kenosha, Wis.
Without obligation
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☐ Have representative call and demonstrate L-225 Set.
Name .....
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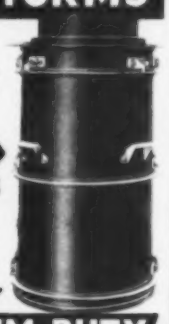
CM6

QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with *Quinn Pipe Forms*. Produce uniform concrete pipe of highest quality.



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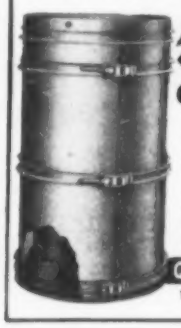
Built to give many years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length.



NEW MEDIUM DUTY CONCRETE PIPE FORMS

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

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For prices and features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs. Also manufacturers of concrete pipe machines for making pipe by machine process.

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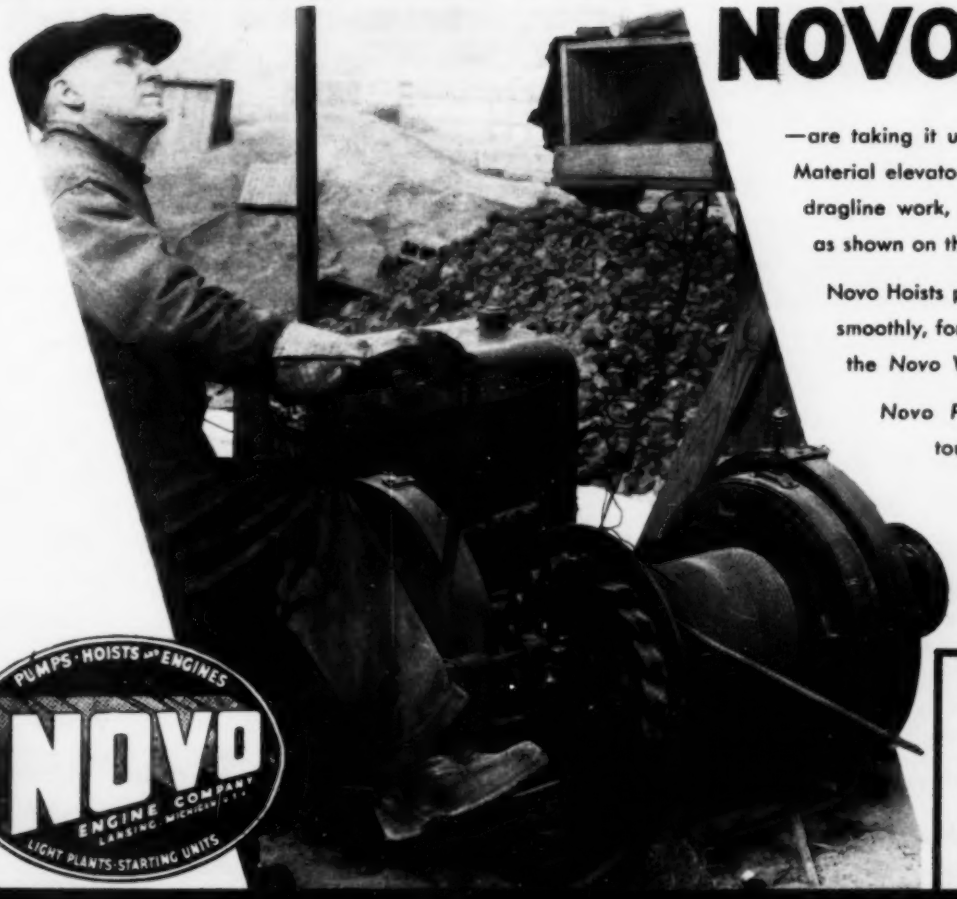

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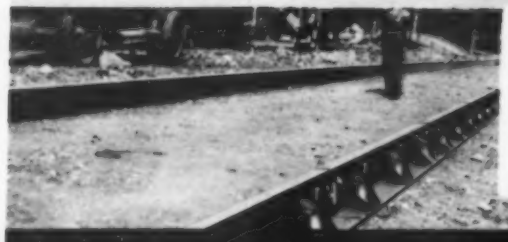

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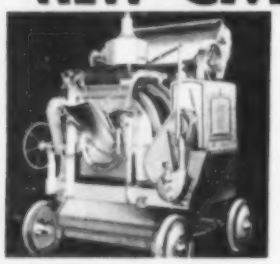

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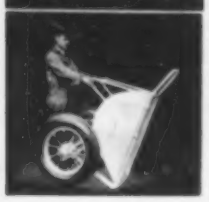

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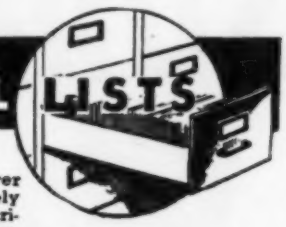

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Athey Truss Wheel Co. 25
Atlas Powder Co. 12
Austin-Western Road Machry. Co. 28-29

Baker Mfg. Co. 113
Barber-Greene Co. 39-88
Barrett Company 15
Blaw-Knox Company 30-98-104
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Calcium Chloride Assoc. 95
Caterpillar Tractor Co. 20-21-22-23
C. H. & E. Mfg. Co. 102
Chain Belt Co. 97
Chevrolet Motor Co. 101
Cleveland Tractor Co. 8-9
Clyde Iron Works, Inc. 88
Columbia Alkali Co. 95
Construction Machinery Co. 114
Complete Mchry. & Equip. Co., Inc. 112
Cummins Engine Co. 37

Dixon Valve & Coupling Co. 110
Dow Chemical Co., The 95
Du Pont de Nemours & Co., Inc., E. I. 18

Electric Tamper & Equip. Co. 112
Emsco Derrick & Equip. Co. 105
Ensign-Bickford Co. 100
Euclid Road Mchry. Co. 5

Flexible Road Joint Machine Co. 106

General Electric Co. 83
General Motors Truck Corp. 34
General Tire & Rubber Co. 107
Goodall Rubber Co. 90
Goodrich Rubber Co., B. F. 99
Goodyear Tire & Rubber Co. 79
Gorman-Rupp Co. 98
Greene, Tweed & Co. 92
Griffin Wellpoint Corp. 112
Gulf Refining Co. 36

Haiss Mfg. Co., George 98
Harber Plywood Corp. 111
Harnischfeger Corp. 31
Hazard Wire Rope Div. (American Chain & Cable Co., Inc.) 3rd Cover
Heltzel Steel Form & Iron Co. 114
Hetherington & Berner, Inc. 94

Inland Steel Co. 2nd Cover
Insley Manufacturing Corp. 103
International Harvester Co. 82
International Nickel Co., Inc., The 84

Jaeger Machine Company 89-110

Keuffel & Esser Co. 106
Killefer Mfg. Corp., Ltd. 88
Koehring Company 16

L & M Mfg. Company 112
La Plant-Choate Mfg. Co. 24
Lehigh Portland Cement Co. 26
Leschen & Sons Co., A. 17
Le Tourneau Inc., R. G. 19
Linde Air Products Company, The 27
Link-Belt Company 4th Cover
Lone Star Cement Corp. 7

Macwhyte Company 86
McGraw-Hill Book Co., Inc. 96-110
Michigan Alkali Co. 95
Mine Safety Appliances Co. 92
Moretrench Corp. 100

National Carbide Corp. 90
National Lock Washer Co., The 100
Northwest Engineering Co. 38
Novo Engine Co. 113

Owen Bucket Co. 87

Page Engineering Co. 77
Portland Cement Ass'n. 85

Quick-Way Truck Shovel Co., The 90
Quinn Wire & Iron Wks. 112

Reed-Prentice Corp. 93
Richmond Screw Anchor Co., Inc. 96
Roebling Sons Co., J. A. 32-33
Rogers Bros. Corp. 118
Rogers Iron Works Co. 94

Schramm, Inc. 106
Searchlight Section 112
Service Section 112
Sinclair Refining Co. 117
Smith Company, T. L. 80
Snap-on Tools, Inc. 111
Solvay Sales Corp. 95
Southwest Welding & Mfg. Co., Inc. 14
Standard Oil Co. (California) 109
Sterling Machinery Corp. 104
Stroudsburg Engine Wks. 112

Texas Company, The 10
Thew Shovel Co. 11
Trimont Mfg. Co. 102

U. S. Steel Corp. Subsidiary 40
Union Carbide & Carbon Corporation 27
Union Metal Mfg. Co. 76
Universal Atlas Cement Co. 40
Universal Crane Co. 11

Wellman Engineering Co. 92
White Manufacturing Co. 112
Wickwire Spencer Steel Co. 13
Williams Co., J. H. 94

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